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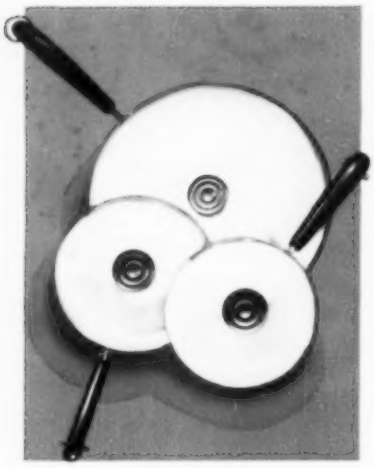
Claimed to be the world's fastest plastics calender ever built, this four-roll equipment has been placed in operation by The Goodyear Tire & Rubber Company, Akron. Built by Adamson-United of Akron, the calender is designed to produce more than 120 miles of film better than six feet wide in a 24-hour day.

PUBLISHED BY THE SOCIETY OF PLASTICS ENGINEERS, INC.



Smart design, fine finish, heat resistance, and low heat conductivity are all found in handles and knobs for famous Revere Ware. They're Black **BAKELITE Heat-Resistant Phenolic BM-13335.**

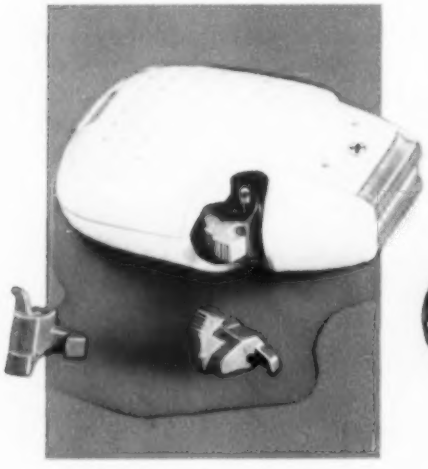
Molded for Revere Copper and Brass, Inc., Rome, N. Y., by Dremolding Corp., Canastota, N. Y., Auburn Button Works, Auburn, N. Y., and Norton Laboratories, Lockport, N. Y.

Impervious to solvents, Baker "Bak-O-Plast" paint brush handles stay smooth and comfortable to the touch. Well balanced, strong, easily produced, they're made of **BAKELITE General-Purpose Phenolic Plastic BM-18450.**

Molded by Shaw Insulator Co., Irvington, N. J., for Baker Brush Co., New York, New York.

Electrical resistivity of these textile pulleys prevents build-up of high static charges as fibers pass over them. Made of **BAKELITE Medium-Impact Resistant Phenolic BM-14111,** they're light in weight, strong, smooth, and wear-resistant.

Made by Meadows Mfg. Co., Atlanta, Ga.

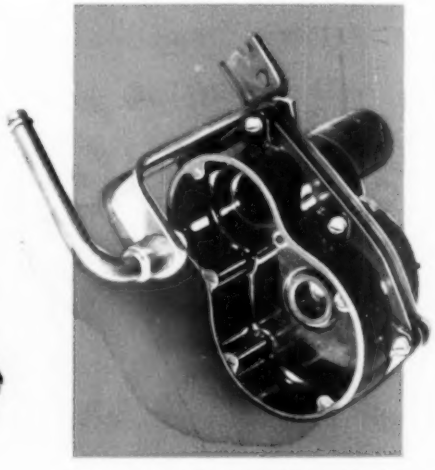


Complex shape, close tolerances, good color, and durability characterize starter buttons for Schick "20" electric shavers. Made of Tan **BAKELITE General-Purpose Phenolic BM-17020,** they have excellent insulating properties and are rapidly mass produced by transfer molding.

Molded by Shaw Insulator Co., Irvington, New Jersey.

This heavy-duty three-terminal electrical connector for trailer coaches has plug and receptacle of Black **BAKELITE Improved-Impact Phenolic BM-6260.** They stand up under a 30 amp., 110 volt current, are resistant to mechanical shock and to moisture.

Molded for Theodore Bargman, Detroit, Mich., by Molded Products Company, Detroit, Mich.



Impact strength, smooth durable finish, and resistance to heat and moisture qualify phenolic plastics for this job! It's an aspirator in the Bendix Economat clothes washer, molded of Black **BAKELITE Impact and Alkali-Resistant Phenolic BM-13080.**

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INDEX

EDITORIAL

Management Looks at SPE—Henry E. Griffith 5

ARTICLES

Quality Control—L. M. Debing 7
Preplasticizing—R. W. Powell 11
Automotive Plastics—John Totten 19
The Role of the Engineer in Sales—E. D. Kennedy 21
Panel on Military Applications 23
Successful Designing for Plastics Molding—W. M. Halliday 26

FEATURES

The Injection Molderscope—A. R. Morse 17

SECTION NEWS

Connecticut 26; Detroit 27; Eastern New England 18; Northern Indiana 18; Northwestern Pennsylvania 17; St. Louis 18; Toledo 18.

ADVERTISERS

Bakelite Co., Div. of Union Carbide and Carbon 2
Barrier-Pribble and Co., Inc. 25
Durez Plastics and Chemicals, Inc. 3
Injection Molder's Supply Co. 6
Manco Products, Inc. 28
Metasap Chemical Co. 27
Newark Die Co. 4

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Management Looks at the SPE

Henry E. Griffith

Vice-President, Plax Corporation

The Plastic Industry, like many growing dynamic industries, is dependent upon the strength of its component units. Like the old fashioned milking stool that stands on three legs, our Plastic Industry depends on the health and growth of Management, Sales and Engineering.

The SPE deserves a "well done" for its continuing efforts to gather the engineers of the Plastic Industry together in common purpose on a regional and national basis.

The common purpose being to broaden the technical knowledge and experience of its members so that they may better serve their companies and management. It is frequently stated and believed that the SPE provides the prime way to learn plastics.

No one of us can be "all things to all people". Much of our value to our company comes from the education gained after graduation from college. Part of this is learned from job experience and training. A great part, for the Plastic Engineer, comes from the schooling and the associates attributable to the SPE.

The young Plastic Engineer learns by contact with others at SPE sponsored meetings. Here's an opportunity to stimulate his professional pride—not only in his work but in the company he represents. Free exchange of experience, guided by astute direction from SPE to avoid controversial subjects dealing with private know-how, gives a background of knowledge not taught in engineering schools and colleges.

Also of value to management is the teaching of customers' engineers who for the progress of the Industry must learn to appreciate and work with the elements confronting them. For instance, one misapplication of plastic material can injure the Industry more seriously than any other single act. Manufacturing, Development and Customers' Engineers in unison, through association with SPE should be able to prevent misuses and so advise Management and Sales. Such understanding can prevent undue costs to company or harm to the Industry.

Book Review

"Machinery and Equipment for Rubber Plastics. Vol. 1—Primary Machinery and Equipment." Compiled by R. G. Seaman and A. M. Merrill. Published by "India Rubber World," 386 Fourth Ave., New York 16, N.Y. Cloth bound; 6 x 9 inches; 804 pages. Price, postpaid: $15 in U.S.; $16 foreign.

Comprehensive engineering information on the primary machines and equipment used by the rubber and plastics industries is presented in this book, the first of its type ever published. Compiled by the editors of "India Rubber World" with the cooperation of an editorial advisory board of experts in the field, the presentation includes much material previously unpublished, together with data hitherto available only from scattered sources.

All machines and equipment are classified into 20 chapters, each further subdivided into sections. Each chapter commences with one or more introductory articles by recognized authorities in the field concerned who discuss design trends, construction principles, and applications. Following the articles come classified descriptions of the machines, including types and sizes, tables of specifications, design features, operation, maintenance and applications. Contributing to ready understanding of the text are 241 illustrations.

The 20 chapters cover mills, mill accessories; mixers; calenders and accessories; extruders; extruder accessories; compression and transfer presses; press accessories; injection presses, molds and mold accessories; web coating and handling equipment; pressure vessels; heaters, sealers, dryers, and coolers; tire and tube machinery; hose and belting machinery; footwear machinery; wire and cable machinery; sole and heel machinery; latex processing machinery; and special plastics machinery.

In addition to engineering information, the book also acts as a directory by listing the manufacturer and his address of each machine or piece of equipment. Thousands of machines, as made by 350 manufacturing firms, are represented in the book. A list of used and rebuilt machinery suppliers is appended, together with useful reference data tables. A comprehensive index permits the quick location of any desired machine.

The value of this book will be self-evident to all engineering, processing, sales and purchasing, and management personnel in the rubber and the plastics industries throughout the world.

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QUALITY CONTROL

L. M. Debing

Monsanto Chemical Co.

A search of the literature for the past 10 years reveals little in the plastics literature about statistical quality control. Undoubtedly the use of statistical methods is more broadly accepted in the plastics industry than indicated by the lack of publicized applications. Greater discussion and publication are urged because only through these mediums is the natural reluctance towards change overcome. The plastics molders are no different than any one else when they explain that "their business is different and doesn't lend itself to the use of S.Q.C." It is true that statistical quality control is not a cure all that can be applied indiscriminately but it does engender thinking processes and an openmindedness in the approach to problems that can be of universal benefit.

What is Statistical Quality Control?

The first reaction of most people is to shy away from the subject of the term "Statistical." Greater acceptance and progress would be made if the word statistical conveyed the concept of applying common sense to the problems of producing quality products. This means the planned exercising of control over all factors playing a part in the quality of the final product.

These factors are:

1. The quality of the raw materials used.
2. The initial adequacy of the processes and the ability to maintain a uniform level of operations.
3. The evaluation of the quality level.

In addition to these strictly production aspects of statistical applications are the indirect benefits of:

1. Designed experiments for maximum information.
2. Clarification of specifications.
3. Graphical presentation of data.
4. Correlations, the study of relationships.
5. Vendor and customer relationships.
6. Training of personnel.

Statistical quality control is founded on two basic principles present in all production. The first of these could be called the Principles of Variability, which runs to the effect that it is never possible to produce two pieces (or two lots) exactly alike. This is readily understood by all production men when related to the products they produce, but all too often forgotten when they set up specifications covering the raw materials and equipment they use.

The second principle might be called the Principle of Uncertainty which

L. M. Debing

covers our inability ever to measure any quality variable with absolute precision. In combination, these two principles leave us in the following position: That we cannot ever build quality into a product to a precise, specified value, and even if we could, we would never know if we were precisely there because of our inability to measure without error. At first hand this would appear to be a poor foundation on which to build, but how to recognize and evaluate these limitations are the objectives of statistical quality control.

Industrial statisticians have divided the causes of product variability into two classes. The first of these is the "assignable causes" of variation which means the process should be subject to correction. This also includes errors due to sampling and testing and may be an important part of an apparent process variation. To the molder of plastics this could be trouble with time cycles in preheating and molding, temperature controls, type of powder being molded, design of mold, and the like.

The second class includes the less

FIGURE 1

Gauge of Sheet (inches × 10⁻³)						
60						
59	1					
58	1					
57	11					
56	11					
55	11111	11111	11111	11		
54	11111	1111				
53	11111	11111	11111	1		
52	11111	11111	111			
51	11111	11111	11111	11111		
50	11111	11111	11111	11111	11111	11111
49	11111	11111	11111	1111		
48	11111	11111	11111	11111	1111	
47	11111	11111	1			
46	11111	11111	1			
45	111					
44	111					
43						

apparent group; those due to "chance causes of variation." These have to do with our inability to obtain precisely the temperature control we desire, the perfect mold surface, absolute pressure control, preforms all having the exact same weight. Variation in molding powder supplies, reliability of instruments, and the weather itself are often the factors that contribute to these chance causes of variation.

The statistician has developed procedures which enable the production man to separate these two causes for variation. Obviously the first step in improving a process is to determine that an observed variation has an assignable cause.

One of the earliest procedures for observing a process was the arranging of the test data collected in the form of a histogram. A typical example is shown in Figure 1.

Uniform Quality

Assuming that the information shown on this histogram on gauge control of plastic film was obtained during a period of time when no trouble of any kind occurred for which assignable causes could be ascertained, then the distribution reflected by the histogram represents the most uniform quality attainable with the present day raw materials and process know-how.

Additional valuable information could have been obtained from these data if the chronological order of the data had been plotted. This is done in Figure 2 for the data shown in the histogram. It now appears that the process control could be improved. Some data points definitely seem too high and there is present a series of points indicating a chance for improvement.

From this beginning the contributions of the statistician have enlarged this approach into our present day control chart techniques. The use of control charts is the technique most widely associated with quality control programs. It should be noted, however, that control charts are only one of the many statistical techniques which have been developed and recently applied to improve not only the production function but also the managerial function of business. The broad scope of statistical applications[1] have been illustrated by examples covering such diverse subjects as:

1. Controlling overtime work.
2. Scientific selection — training — management personnel.
3. Verifying clerical work.
4. Simplification of financial reports.
5. Accident prevention work.
6. Statistical Controls in Sales work.
7. Statistical control in engineering design.
8. Testing and marketing of goods.
9. Statistical control of labor costs.

Figure 3, once again shows the data presented in Figures 1 and 2. In this figure lines have been added following statistical procedures. The lines marked UCL and LCL are upper and lower control limits. Based on the bell shaped configuration of the data in the histogram, the statistician tells us that 99.7% of our subsequent processing data will fall between these two limits if the same state of process control is maintained. If points fall outside of these limits or if anomalous series of data are obtained as shown in Figure 3, then the statistician assures us that these process changes are significant and not due to those, as yet, uncontrollable causes of variation.

Figure 4 shows a process control chart on washing plastic film. The chart reveals that about the middle of July something occurred to throw this process out of control. Although the process is operating well within specifications (lint count 3) such an out of control situation should be corrected. This was done around August 1. The study by production paid off well as shown by a lower level of operations within a slightly narrower range.

Control Charts

Numerous techniques have been developed to obtain maximum information from control charts. In addition to the obvious "out of control points," trends can be noted and corrective action initiated before the process goes out of bounds and even better an analysis of the data will sometimes indicate that the process can do better if some periodic or cyclic trends are present.

As pointed out previously this phase of statistical quality control deals with the production man's problem of keeping his process on the beam. Space does not permit discussing the numerous additional contributions made by the statistician to answer problems dealing with scientific sampling, inspection problems, design of experiments and analysis of data, correlation of studies, presentation of data, and tests for significance or level of confidence that can be placed in the interpretation of the data, etc.

Because of the broad aspects of S.Q.C., the following examples concern only the 3 factors referred to as directly affecting the quality of products.

S.Q.C. and Raw Materials

The molder of plastics unquestionably recognizes the important part that variability of plastic sheets or powder play in the efficiency of his operations. Liberal credit arrangements covering the return of faulty goods are not the sole answer to this problem. The importance of exercising control in a positive sense is becoming more and more recognized.

For example, one molder installed his own test for determining the plasticity of thermosetting molding powders. By keeping a check on this vari-

Figure 2. A plot of the histogram in figure 1.

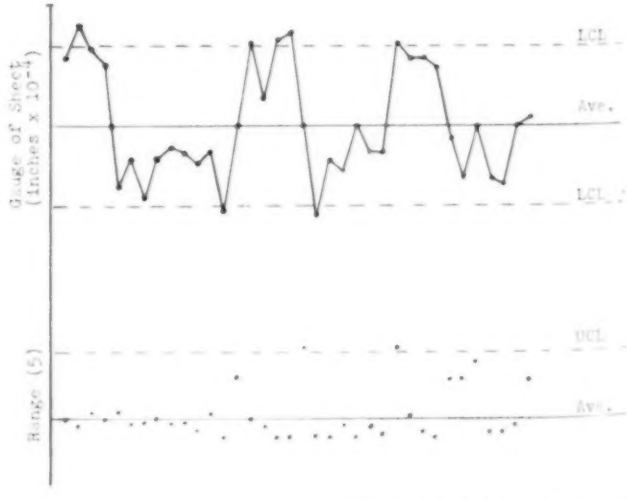

Figure 3. The data of figures 1 and 2 plotted with upper and lower control limits. →

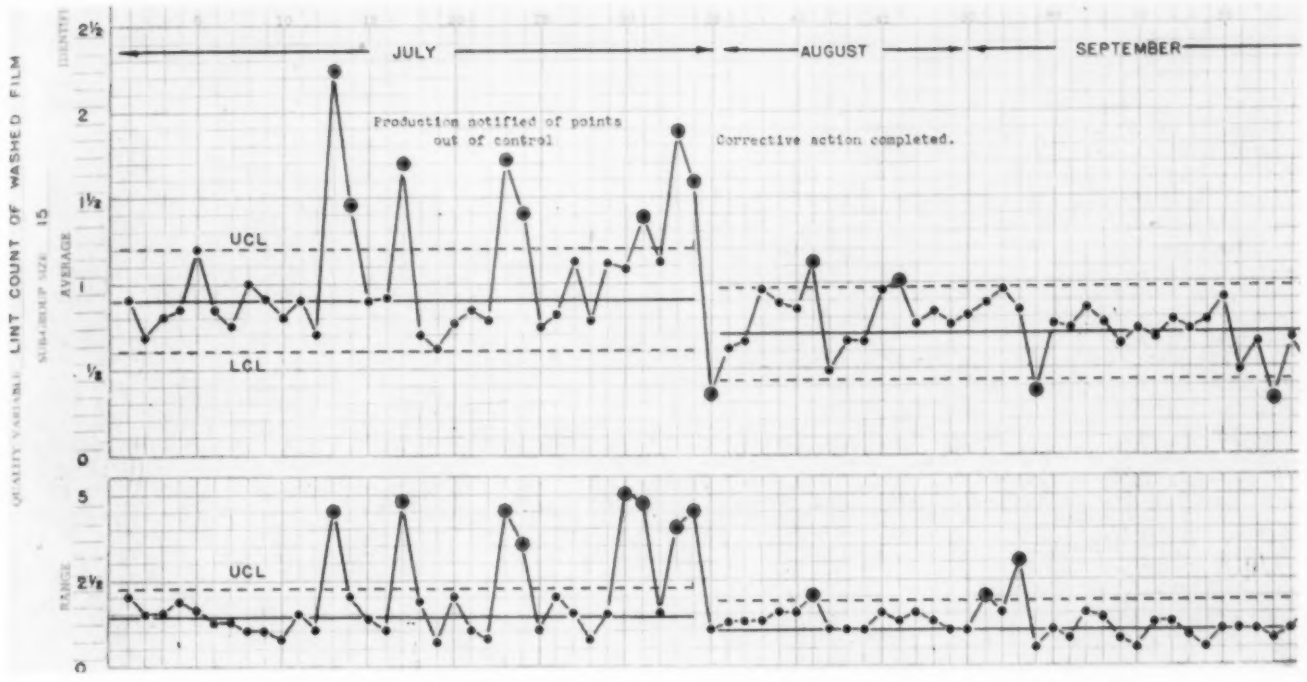

Figure 4. Process control chart on washing of plastic film, showing "out of control" in July, and effect of corrective action

able and correlating it with the plasticity requirements of specific molds, he is able to avoid delays in preparing preforms. The usual practice is to make up preforms only after running a trial lot in the actual mold. Such records, when plotted on control charts, will soon establish the variation in plasticity allowable. Additional information as to uniformity of shipments from vendors, variation trouble of preforming itself, degree of preheating required, the effect of humidity changes and others can as readily be determined. Still other causes for variation can come to light as successive causes for variation are minimized or removed.

Flat Tile Check

Another concern checks the color of incoming raw material by molding a flat tile in a production mold. The molded pieces are subjected to detailed inspecting by comparsion with standards. The thickness of the tile, a secondary check on plasticity, is noted and plotted on a control chart. The charts revealed that one press was consistently producing overly thick tiles. A check of the press showed that the backing shims had been compressed and new shimming was necessary. Thus, a method of recording information about a raw material revealed a production deficiency.

The sampling procedure used was to take a sample from each of two different bags taken from each lot. A lot in this case was a batch or a blend as indicated by the vendor. Per cent defectives noted in the sample were recorded. The sampling was considered adequate since each "lot" was a single blend of material. The two samples were a check on the efficiency or uniformity of blending. Experience was revealing that this was a minor source of difficulty.

The most common practice is to check incoming material by trial tests in the production mold for which it was purchased. This "proof of the pudding" test is difficult to quarrel with but it is an empirical method of testing and very little data of a useful nature finds its way back to the producer of plastics.

Metal Inserts

Molders appear more inclined to check the quality of the metal inserts they use. This is no doubt due in part to the relatively easy checking of specifications plus their classification as special items not readily returnable to the vendor. Inserts can be sampled by a variety of plans. Being a product of automatic screw machines in most cases, the product could very well have been manufactured under statistical quality control. Some of the earliest and most encouraging results with S.Q.C. have been obtained with screw machine operations. Molders might profitably check with their vendors of inserts to determine their familiarity with S.Q.C. methods. They may find that they could obtain a statement on quality of their inserts from the vendor based on his statistical quality control. There is a definite trend on the part of larger consumers to reduce their costs of checking the quality of incoming raw materials through reliance on the vendor's statement of quality based on his (the vendor's) use of statistical control methods. The molder, in his role as a vendor, can obviously be expected to "compete" in the same manner. Interesting vendor-relationship booklets have been issud by the Ford Motor Company, General Electric Co., (Erie Works and Telechron Department), The Budd Company and Hunter Spring Company, and others.

S.Q.C. and Process Control

Process control charts could readily be used throughout a molding shop, as readily in fact as they are used in screw machine operations. With the larger number of controllable factors to contend with in the molding operations it is not unreasonable to believe the benefits of control could be as great or greater.

Not long ago the control of quality in the average molding shop was vested entirely in the hands of the molding shop foreman. His job was primarily that of a trouble shooter and he rarely had time to exact any degree of control to obtain maximum efficiency and quality of output. This lack of control of the process was usually amply compensated for (manpower-wise) in the final inspection departments.

Today fewer men are being employed in final inspection because roving inspectors are being used in the molding shop to control the quality of the product as it is produced. They are usually given a specific number of presses to oversee. They make periodic checks on the quality of product produced at each press. When a press is found to be producing off grade material a card noting this observation, sometimes including the percent defect noted, is dropped in the tote box. Any box bearing such a tag requires subsequent 100 percent inspection. If the defect is serious enough to warrant shutdown the foreman is notified. Sometimes a red flag is raised on the press to bring the foreman on the run. If only a cavity or

two of a multiple cavity mold are defective these are blanked off if possible and the press tagged for repair.

However, in many cases the emphasis is more closely related to inspection than process control. Process control would include greater attention to the variables affecting the molding operations and the causes for the defects. Improved process control becomes the natural by-product of properly charted data. If the data which the roving shop inspector collects are plotted on control charts it is almost certain that the charts will pin point the change of conditions which have resulted in a change of quality. The need for controlling the variables of molding is best made apparent when the cost of production is correlated with mold repair, downtime or material losses caused by faulty operations.

In the injection molding of thermoplastic molding powders, control charts maintained on cylinder and mold temperatures are found to be an aid toward uniformity of moldings. Process sampling at the inspection machines to assure an average quality level of not more than 4% defective material is used to avoid wasting time and material in subsequent assembly and finishing operations. The final product is also sampled to assure an average outgoing quality level of 4%.

The abundant information that can be learned concerning a process through a systematic study of the final product produced has been ably demonstrated in the study of calendered film.[2]

Film Variations

Mr. Oladko studied samples of various commercial films and related variations in weight of the sheet stock to the factors in design controlling the variability in gauge. From the numerous conclusions arrived at concerning calendering, the following more general conclusions are of interest and are quoted since they could apply equally well to molding operations.

1. "Due to the nature of calenders, it is extremely difficult to precisely measure such factors as crown, eccentricity, distortion, etc. Measurement of the product, which can be done much more accurately, will indicate exactly what the calender is producing.

2. "Process capability studies invariably show what is happening within a process. This technique of modern quality control measures the finished product which after all, is the prime concern of producer and consumer. It not only lays bare the results of the process but indicates the action to be taken to improve the results.

3. "Opinions based on opinions go out the window. A process capability study always presents indisputable and reproducible facts.

4. "Finally, and perhaps most important, knowledge of the process leads to greater uniformity of product. It is difficult to place any tangible value upon quality, performance of product, consumer reaction, etc., but in many cases it can exceed the dollar savings within a plant due to elimination of overages, scrap rework, etc."

S.Q.C. and Evaluation of Quality Levels

The determination of the quality of the product produced prior to shipment or the determination of the product quality by the consumer prior to acceptance has been a fertile ground for study by the statisticians. Various sampling plans have been devised to give maximum information at various degrees of cost. One of the most recent of these plans is the Lot-Plot plan[3] which was designed to reduce the risk of defective material getting by 100% inspection in an aircraft propeller machine shop.

As with all industries, there is no doubt a range of from no inspection to 100% inspection within the plastics industry. A grab sample is still an extremely popular procedure. Concerns which have used such procedures for years feel justified in continuing this procedure on the basis that their returns are not excessive. This of course assumes that the customer does not mind returning faulty material for credit and that he is not likely to turn to a more reliable producer. Of additional importance is that variation in size and randomness of the grab sample often fails to produce information that can be of assured usefulness for future reference.

Sampling

As previously mentioned, more and more customers are asking their vendors "What are you doing with Statistical Quality Control?" and "What sampling procedures do you use?" It is a rather common occurrence for a customer using statistical methods to inform his vendor that something has gone wrong with the vendor's process or that the process, if straightened out, is actually capable of giving (the customer) an improved product. Mr. Juran[4] illustrates this latter point wherein a molder of a plastic button claimed he would be unable to conform to a dimensional specification. The customer requested the molder to mold 5 heats of 3 different materials and to keep each heat separate. The customer then statistically analyzed the data taken from these runs and demonstrated to the molder that only minor changes in a few cavities were necessary to obtain the desired level of quality.

Other Statistical Applications

It would do the science of industrial statistics a disservice not to include a few examples not directly concerned with quality control or quality evaluation. Mr. Adams[5] has discussed the use of two "factorial" design experiments which demonstrates the value of applied statistics in the field of plastics physical testing. One of these experiments concerned the Izod impact strength of polystyrene and the factors studied were the difference between two laboratories, specimen notching (gate end versus dead end) testing machines and the manner in which the specimen is mounted in the machine. In this investigation each laboratory tested 24 pieces yet an average of 24 breaks appeared in each of the calculations covering each of the four variables. The primary cause of variability was found in the manner used for clamping the specimen in the test machine.

The second experiment concerned a study of the variables in injection molding process and their effect on the physical properties in general. In this latter case, statistical design of the experiment and statistical analysis of the test data uncovered interactions or inter-relations between machine factors, type of powders, temperatures, etc., that could easily have been missed by the usual methods of experimentation. The usual method or classical method is to investigate one variable at a time while holding all others constant. This is not necessary with statistical methods and experimentation is, therefore, both broadened and hastened.

Another problem[6] was to determine if one molding powder was superior to another in preforming properties. The customer reported greater pill weight variation with Material A than with Material B. Data were collected by running each material through the preformer under standard operating conditions. The effect of hopper level and drum to drum variation was also investigated. Preforms were collected in groups of 10 at random during the runs, weighed and the weights recorded.

Various statistical techniques were

(Continued on page 25)

(1) Mueller, R. K.,—Effective Management Through Probability Controls, Funk and Wagnalls Company, New York, N. Y.

(2) Oladko, A., Developing a Calendergraph, Rubber Age, September 1949.

(3) Shainin, D., Recent Lot Plot Experiences Around the Country, Quality Control Conference Papers, 1951, American Society for Quality Control.

(4) Juran, J. M., Quality-Control Handbook, McGraw-Hill Book Co., New York, N. Y.

(5) Adams, C. H., Application of Statistical Techniques to the Physical Testing of Plastics, Abstract of Paper 1949, A.S.Q.C. Convention.

(6) Abstract of Paper, Third Annual Convention, 1949 American Society for Quality Control.

R. W. Powell

PRE-PLASTICIZING

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Among the advantages claimed for preplasticizing are: increase of plasticizing capacity for a given machine, greater shot capacity, relatively strain-free molded parts, reduction of weight of molded piece with consequent reduction of scrap and saving of money. The 300 ounce injection machine is being planned.

Introduction

It is a pleasure to talk to you briefly on the subject of pre-plasticizing types of injection molding machines. My talk will be restricted to those built by The Hydraulic Press Mfg. Company of Mount Gilead, Ohio. Many of you are familiar with pre-plasticizing molding machines, especially the types which will be described, as we have been in production with this type of equipment for approximately one year. Pre-plasticizing is not new. H-P-M machines, built in the early 30's employed pre-plasticizing methods. This was before the development of the spreader or pineapple which has been used in conventional injection machines for many years. At that time, the H-P-M pre-plasticizing unit was known as a "tunnel" and fed plasticized material into an injection sleeve similar to present day pre-plasticizing methods. The "tunnel machines" were a crude approach to the plasticizing problem and machines in that day were limited in shot capacity to a fraction of an ounce. The development of the spreader or pineapple made obsolete the small tunnels used on the very early injection molding machines. Today, we combine the best features of the tunnel machine with that of an efficient spreader and the results to date have been very gratifying.

Advantages

H-P-M pre-plasticizing machines have been developed for use with the conventional injection molding machine frames, and materials molded with these pre-plasticizing units are the commonly used thermo-plastics, particularly polystyrene and the cellulosic materials. In pre-plasticizing the granulated or powdered molding material is completely plasticized before coming in contact with the injection plunger.

The advantages of such a method are legion, and molders have long desired for a machine which would produce superior parts to those made in conventional machines. You as molders have long realized the limitations of the conventional machine, particularly in respect to plasticizing capacity and the tremendous injection pressures which were required in order to fill cavities. One may ask, "why it has taken so long for the development of the pre-plasticizing machine?" Basically machinery builders were reluctant to change designs radically. This is true in most machinery lines and the injection machine builder is not alone on this score. First of all true pre-plasticizing required a complete change in thinking with regards to machine design. Conventional methods were not right for this new approach to injection molding. Even today, many injection molders are skeptical of pre-plasticizing and what it will do for them. Matter of fact, at H-P-M, we manufacture a great many more conventional machines than we do pre-plasticizing machines, but every pre-plasticizing machine which has been put into a molding plant becomes more convincing evidence that this is the right approach to injection molding. It is true that we have adopted principles used in the past, but like many developments, someone must pioneer and actually do the job.

Before getting into the details of the machine design, we believe it would be well to review some of the advantages which pre-plasticizing offers to the injection molder. Many of these claims will appear to be fantastic and many are not based upon, should we say, strictly technical laboratory tests. This development is still too new to be able to give to you actual test information, but we do have actual production results from several machines which we believe will be of interest to you. In all cases, we will not always be able to explain technically why such favorable results occured, but like most developments, there have been a great many "trial and error" calculations in arriving at the results.

One of the most important advantages which pre-plasticizing offers to the injection molder is the increase in plasticizing capacity on a given size machine. For example, one of our standard size machines is that which employs a conventional 16 ounce capacity machine frame and mold clamping unit. On this particular machine, when built as a conventional 16 ounce capacity machine, our plasticizing rate when molding polystyrene amounts to 75 pounds per hour. When a pre-plasticizing conversion unit is employed with this basic 16 ounce machine frame, it is possible to secure up to 150 pounds of plasticizing capacity in polystyrene per hour. You as an injection molder can readily visualize the importance of increased plasticizing on a given size machine.

Shot Capacity

The shot capacity of the machine has been greatly increased by the pre-plasticizing unit. The conventional 16 ounce machine, which would injection mold a maximum of 16 ounces of polystyrene per shot using a single injection stroke, now becomes a 48 ounce polystyrene machine. This may or may not be important on a certain given machine frame size, but we will later describe machines for the future which can utilize this increased shot capacity to a maximum advantage. Even with today's machine sizes and the mold mounting surfaces of these machines, which incidentally are much too small for pre-plasticizing units, there are many molding jobs which can utilize the increased shot capacity of the pre-plasticizing injection unit. Such capacities are not restricted to thick moldings but consideration can be given to multiple die cavity molds for relatively large parts, particularly parts with considerable depth where the weight factor has been a limiting problem.

Production Results

Production results have proven that parts molded with pre-plasticizing machines are relatively strain free. Many

polystyrene parts which are sold on the competitive market cannot warrant the cost of heat treating in the price structure. On parts of this type, the molder has to take a chance and the result is considerable scrap loss from breakage or defects not only in his own plant but also in transporting these parts to the merchandiser or consumer. Why is it possible to secure relatively strain free moldings with the pre-plasticizer? Here again, we as machinery builders, have not made the laboratory tests to prove the cause of strain, but material manufacturers have done a great deal of research in this field and it is believed that high injection pressures, particularly after the mold cavities have been filled, produce most of these strains. With the pre-plasticizing machine, high injection pressures of this type do not exist. Mold cavities are usually filled with 6,000 to 8,000 p.s.i. pressure and with the H-P-M pre-plasticizing machines, we have reduced this injection pressure automatically after the mold is filled.

Weight Reduction

Another very amazing result when pre-plasticizing is employed is in the total weight of the part produced with a pre-plasticizing machine. In most actual production jobs which have been molded with our pre-plasticizing units, the parts will weigh at least 10% less than those made with the same mold with conventional injection molding machines. We do not have a technical answer as to why this weight saving occurs, but it is believed to be caused by two factors. First of all, when conventional machines are employed, it is not unusual for the mold clamp to open up slightly making the part actually thicker than the engineering standards of the mold. This opening up is not enough to produce flash and the part as a whole appears to be perfectly satisfactory. It is just thicker than the part which was actually engineered into the mold. Secondly, we are of the opinion that the specific gravity of the part is changed when made with a pre-plasticizing machine. How much, we do not know, as we have made no research tests in this field. We believe that both of these conditions are basically caused by the lower injection pressures which are used with the pre-plasticizing machine, but we have yet to find a single part made on a pre-plasticizing unit which did not weigh less than the same part made in a conventional injection molding machine.

Money Saved

One molder employing a pre-plasticizing machine calculated that on this specific weight saving alone on a single $10\frac{1}{2}$ oz. part, if the part were molded for an entire year, would actually save him approximately $10,000 in material cost alone!

We have actually had some amazing weight saving results with parts dropping from 26 to 20 ounces and the parts made with the pre-plasticizing machine being perfectly satisfactory from an application standpoint.

One of the "bug-a-boos" of injection molding, particularly polystyrene, has been the high temperatures which were required in order to secure plasticizing capacity from conventional heating chambers. It is not uncommon practice to use pyrometer temperature readings of 600 to 650 degrees Fahrenheit when molding polystyrene with conventional machines. With the pre-plasticizing machine, you never mold polystyrene material above its burning point, consequently there is no chance of actually burning the material. Regardless of whether the operator misses a cycle or whether you change a mold in a machine, there is no need to tamper with the heat. The first shot after the mold is changed will be perfect.

With the pre-plasticizing machine, there is a more effective utilization of the mold clamping force. No longer are 2 to 3 clamping tons per square inch of projected area required in injection molding. We like to be conservative in our recommendations on this point, but we feel quite confident that you can mold most parts with clamping forces of approximately $1\frac{1}{2}$ tons per square inch of projected area. We all realize there are exceptions to the general rule and this is particularly true of thin parts of extensive area. In these cases, we know that high clamping forces are needed.

Distortion

To give an example of what has been accomplished in one of our 48 ounce machines, we have actually molded a refrigerator part having 282 square inches in our 350 ton clamping machine. This part has a thickness of approximately .090" and was molded from polystyrene. This part weighed $17\frac{1}{2}$ ounces and was molded on a 45 second cycle. In future molding machines, we intend to use larger mold mounting platens which we feel will be a very welcome change in injection machine design.

In many cases, parts molded with the pre-plasticizing machine come from the mold in a flatter state than those made with conventional machines. There is less distortion in the part and this has been a welcome feature to injection molders who are making products which require the cementing of one part to another.

Many of the molders using our pre-plasticizing machines have commented on how easily the part releases from the mold. Undoubtedly this is due to the lower injection pressures used with pre-plasticizing units and the use of mold release compounds has been practically eliminated when such machines are employed.

For those using dry colored materials, we have definitely proved that the pre-plasticizing unit will give a better color. Without using concentrates, it is practically impossible to mottle with the pre-plasticizing machine. The plastic material is evenly plasticized and has a long soaking period which aids in blending any two colors into a common color. This efficient plasticization plus the soaking period is the reason why dry colored materials have a better color blend. We cannot say that the pre-plasticizing machine will perfectly color dry colored materials, but the color streaks which normally occur have been practically eliminated.

In addition to the better color blending, the appearance of the finish and the color on the surface has been greatly improved.

Temperature Control

We feel that we have much better temperature control on the plasticized material than we do in conventional machines. We normally have five different points of temperature control on the pre-plasticizing unit and the actual method by which we plasticize material provides for a more uniform distribution of heat in the material.

With the pre-plasticizing unit, there is no lost injection plunger movement. As soon as the injection plunger starts forward, material is injected into the mold.

Many injection molders have been skeptical of pre-plasticizing and there has been a great deal of talk concerning discoloration. With proper operation of the pre-plasticizing machine, there is no chance of discoloration. We have machines which have been operating in the field for many months and it is a known fact that discoloration does not occur. The misadjustments of various temperature zones can cause a discoloration usually by trapping gas in some part of the injection assembly, but when temperature zones are correctly adjusted, this trapped gas condition will disappear, and the parts will be molded completely free of any type of discoloration.

The surface of the spreader is much greater than that found in conventional machines. Its shape is like a large turnip with flat sections top and bottom. Its assembly is of a leak proof design.

Pulsating Feed

We employ a pulsating type of feed where small amounts of material are fed into the plasticizing chamber rather than working a large cold slug of material into a heating chamber, such as is done with conventional machines. Molders are familiar with the fact that when they mold a small capacity shot on a conventional machine of specific size they secure a higher plasticizing capacity from the heater than when a large shot is run on this same size machine. Our 48 ounce unit which mounts on a 16 ounce conventional machine frame employs a feeding mechanism where

1... ounces of polystyrene are forced ... the heating chamber with each ...oke of the feed plunger. This plun... operates at a rate of 28 strokes ... minute. You can readily see that ... such a unit that we feed the cold ...olding material into the chamber ... rather small amounts. This makes ... a much more even temperature of ... plasticized material in the cham...

Specific Pressure

We have eliminated the use of a measured feeding mechanism. The pulsating plunger continues to feed material into the injection sleeve until the sleeve has been entirely filled. Then the feed plunger automatically stops.

We fill each mold with a specific injection pressure. We do not attempt to control the amount of plunger stroke by fixed positions. Instead, the machine operates on a principle that it takes a certain pressure to fill each mold and as soon as that pressure is reached, the injection pressure is automatically reduced to a lower holding pressure.

Gasses are formed when material is plasticized, and there is trapped air which must be expelled from the injection sleeve before injection can take place. We eliminate the gas and trapped air by the use of controlled plastic leakages around the injection plunger and the slide valves which control the plastic flow of the plasticized material in the injection unit. These leakages are not excessive, but they do eliminate any trapped air or gas or stagnant plastic material from the injection assembly. The success of our pre-plasticizing unit rests on these controlled leakages and this is probably one reason why pre-plasticizing has been so long in becoming perfected. Injection machine designers were reluctant to adopt the controlled leakage design.

Figure one is an illustration of our 16 ounce conventional machine equipped with a 48 ounce pre-plasticizing injection unit. You will note that the pre-plasticizing unit is mounted on the two injection strain rods which normally supported the conventional 16 ounce injection unit. We offer this pre-plasticizing unit on both new 16 ounce injection machine frames and also as a conversion unit to old 16 ounce machines in the field. The maximum mold mounting surface of this machine is 20"x32½", the maximum daylight between die head and platen is 32" and the maximum ram travel is 20". Maximum injection pressure of material is 15,000 p.s.i., although a majority of molding applications require less than 10,000 p.s.i. With exception of a 40 gallon, 1000 ... gear pump power unit for supplying hydraulic fluid for operating ... feed plunger and plastic flow control valves, the machine employs a standard 16 ounce conventional hydraulic circuit. It is not a difficult

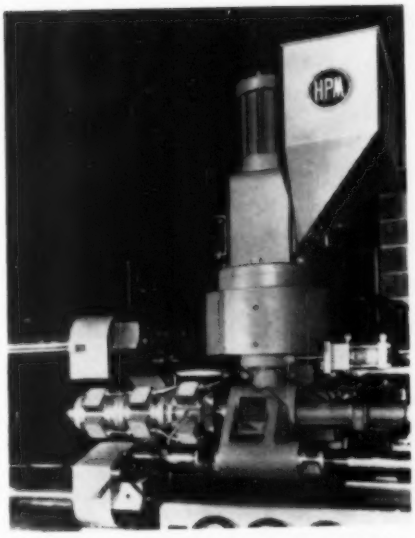


Figure 1. Forty-eight ounce preplasticizing unit

matter to convert an old H-P-M 16 ounce machine to this new pre-plasticizing method. In addition to exchanging the injection units, the electrical control circuit must have certain modifications in order to accommodate this new pre-plasticizing conversion.

The die head has been retracted to provide a better view of the nozzle extension. At the top of the unit, notice the hydraulic cylinder and ram assembly used for feeding the plastic material into the heating chamber. Directly below the chamber you will note a small hydraulic cylinder and ram assembly which operates what we term a slide valve or plastic flow control valve. Directly below this is the injection sleeve, and injection plunger. A stop collar has been provided on this plunger, because less stroke is used in the 48 ounce pre-plasticizing unit than in the original 16 ounce conventional machine. The nozzle extension unit is equipped with Calrod type cast aluminum heating bands. The square boxes are conduit boxes which are cast integral with the heating bands. On some units, in place of the cast aluminum bands, we employ the narrow high temperature Mica bands. Another slide valve or plastic flow control valve is located in the nozzle extension and the hydraulic cylinder and ram assembly which operates this flow control valve is mounted at the rear of the nozzle extension.

Figure 2: Here is diagrammatically illustrated the feed unit, the pre-plasticizing chamber, the flow control valves, injection sleeve, plunger and nozzle extension units. The stuffing or feed ram operates at a rate of 28 strokes per minute. Feeding of the granular material from the hopper into the feed bushing is by gravity. This illustration shows the pre-plasticizing chamber with turnip shaped spreader. Directly below the plasticizing chamber is the first plastic flow control valve. This valve is basically a round stem with a groove machined around it and we hydraulically position the groove in line with the plastic flow, or by sliding the unit horizontally, shut off the plastic flow. In this particular unit, when one slide valve is open, the other is automatically closed. The injection sleeve holds 48 ounces of polystyrene and we stuff it full of plasticized material before each injection shot. Only whatever is required to fill the mold is displaced from the injection sleeve on each shot. In order to fill the sleeve, the front nozzle extension slide valve must be closed and the plastic flow control valve below the pre-plasticizing chamber opened. In order to eliminate plastic being forced backwards through the pre-plasticizing chamber during injection, the slide valve below the pot is closed and the nozzle extension slide valve opened before injection takes place.

Actually all of the material is plasticized before it enters the injection sleeve and no plasticizing is done in any part of the unit below the pre-plasticizing chamber. Although we retract the injection plunger hydraulic-

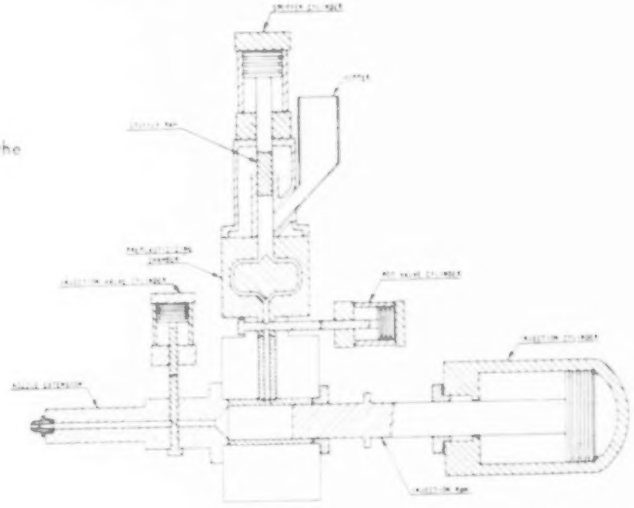


Figure 2. Diagram of the plasticizing unit

ally, we stop it approximateiy $\frac{1}{2}$" before the end of the stroke and then employ the stuffer plunger to force plasticized material against the injection plunger for the last $\frac{1}{2}$". This develops a pressure in the injection sleeve which forces the gas and trapped air from the injection sleeve. Controlled plastic leakages are permitted at the back end of the injection plunger and at each of the slide valves. These clearances provide vents for escaping gas and trapped air.

Due to the fact that we are employing plasticized material directly in front of the injection plunger, we have designed the machine's hydraulic circuit so that clamp pressure must be developed before injection can take place. This prevents the possibility of injecting hot plastic into an open mold on an automatic cycle. When operated manually, the machine does not have this safety factor, so that you can purge the injection unit when changing colors or changing from one material to another without operating the mold clamp. With regards to color changes, we have actually changed from white impact polystyrene to clear regular grade polystyrene in 25 pounds. It is more difficult to change or purge the injection unit from one type of material to another. We do not have any data regarding the amount of material this type of change requires, but basically it is not any more difficult than in a conventional machine, the only exception being that with the pre-plasticizing chamber, it is not possible to dismantle the unit and consequently it must be purged clean.

When changing colors, we recommend that the plunger be removed from the machine after the pre-plasticizing chamber has been purged of the initial color, as the plunger is hot and a small amount of the original color material will adhere to the end or face of the plunger and this material must be scraped off before the color change can be completed. It is a very simple matter to remove the injection plunger from the machine. The illustration does not show the plunger coupling. No more than 5 minutes is required to remove the plunger, clean the face of it and insert it back into the machine. We do not heat the plunger, but the hot plasticized material does heat the plunger by conductivity.

Again I would like to stress that we fill all molds by a specific injection pressure rather than by positioning the injection plunger. For example, if you were molding a 24 ounce shot, the injection plunger would advance half of the distance in the injection sleeve and as soon as a predetermined pressure was reached, the hydraulic system serving the injection plunger would automatically lower the line pressure to a low pressure injection dwell. This dwell would be electronically timed and the plunger would be retracted whenever the predetermined time has elapsed.

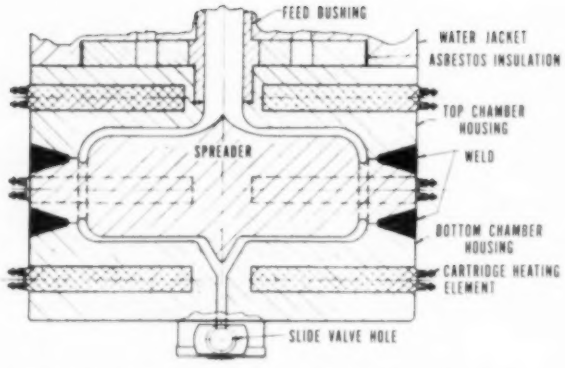
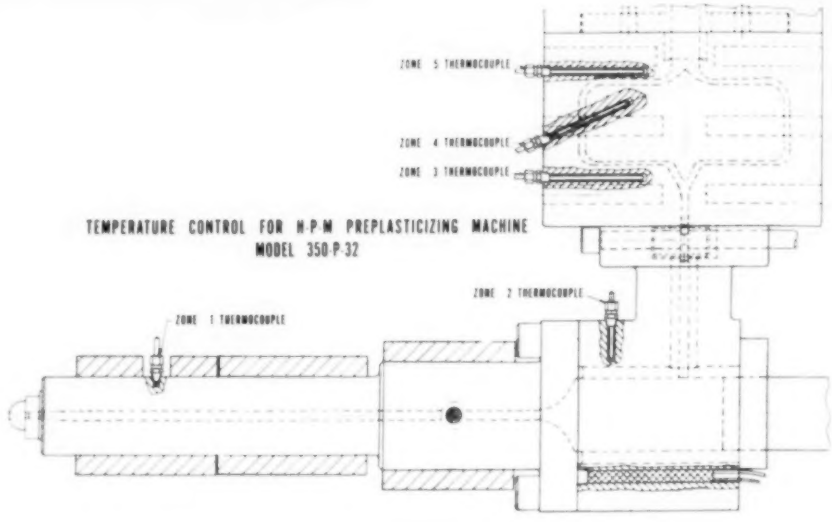


Figure 3. The pl[illegible]cizing chamber.

PLASTICIZING CHAMBER FOR H-P-M INJECTION MOLDING MACHINE MODEL 350-P-32

Figure 4. A diagram showing the temperature control units.



TEMPERATURE CONTROL FOR H-P-M PREPLASTICIZING MACHINE MODEL 350-P-32

Figure 3: This is a diagrammatic drawing of the pre-plasticizing chamber. At the top is illustrated the feed bushing and a water jacket is provided to minimize the heat transfer from the plasticizing chamber. Basically, the plasticizing chamber is made up from three major parts, the top and bottom housings and the spreader. You will note that the spreader is designed with a flange around its entire circumference. This permits the welding of the unit into one integral part thus providing a leak proof assembly. Drilled holes are provided through the flange areas vertically to permit proper plastic flow. The entire welded unit is round in shape and cartridge type heating elements are inserted radially around the unit. This design provides for a very efficient heat transfer to the chamber housing and spreader. Near the bottom of the chamber is the hole for insertion of the first plastic flow control valve. The bottom of the pre-plasticizing chamber is lapped to a bushing which provides the connection between the plasticizing chamber and the injection sleeve.

One must be very careful that the molding material used contains no foreign matter such as steel. Small foreign elements will pass through the plasticizing unit but in case a large foreign element was lodged in the unit, it would necessitate the removal of the welds so the chamber could be dismantled and re-assembled and again welded. There has been considerable objection to this all welded design, due to the fact that it cannot be easily dismantled and re-assembled. In actual operation, it has not proved to be a serious matter, and when one considers that we have a leak proof assembly plus an efficient heating chamber, it is a case of balancing this one factor against many favorable ones.

The design of the spreader unit provides for a great deal of heating surface area. This makes for an efficient chamber. The cartridge heating elements can be easily removed and even those heating the spreader unit are accessible from the outside of the chamber.

Figure 4: This drawing basically illustrates the location of the thermocouples and the five heat zones of the pre-plasticizing injection assembly. Also illustrated is one of several cartridge heating elements mounted radially around the injection sleeve. Band heaters are used on the nozzle extension. The detail of the slide valve

of plastic flow control valve at the bottom of the pre-plasticizing chamber has been dotted in to show the general design of this part.

Although we employ a movable die head on this machine, to gain access to the rear of the sprue bushing of the mold, a quick manual movement of the nozzle extension flow control valve will normally eject a stuck sprue from the sprue bushing without need of moving the die head forward. There is enough pressure developed in the injection sleeve, without use of the injection plunger, to transmit pressure up through the nozzle extension and force the sprue out of the sprue bushing without actually injecting any plasticized material into the sprue bushing. This is one item which was not designed into the machine, but happens to be very useful.

Top Control

We control the top part of the chamber and the bottom of the chamber independently. A separate thermocouple is supplied for the spreader. The injection sleeve has a thermocouple as well as the nozzle extension. To give some idea as to the pyrometer temperature readings employed when polystyrene is molded, zone 1, at the nozzle extension, is maintained at a temperature of 400°F. Zone 2 at the injection sleeve is maintained at 410°F. The bottom of the plasticizing chamber is maintained at 450°F., the spreader at 450°F. and the top of the chamber at 460°F. All of these temperatures are below the burning point of polystyrene and consequently they can be maintained without serious damage to the plastic material.

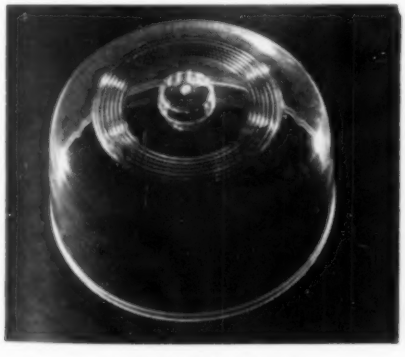


Figure 5. Cake Cover

Figure 5: Here is a clear polystyrene cage cover molded by Columbus Plastics. The shot weighs 8⅝ ounces and the overall cycle is 36 seconds. The wall section of this part is .050". This molder has found it very difficult to mold this part in a conventional machine and normally a 32 ounce or 48 ounce conventional machine was employed when the part was made. Parts made in the pre-plasticizing machine are relatively strain free and a large number of strains were inherent in the part when made with conventional machines. Scrap loss was

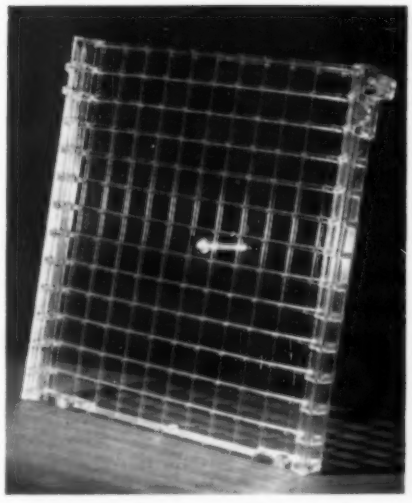


Figure 6. Hydrator Cover

quite high in handling and shipping this part and actually the part could not be flexed to any extent without cracking it. Now when it is made in the pre-plasticizing machine, it has great flexibility and scrap loss has been reduced to nearly zero.

Figure 6: Many injection molders are familiar with this hydrator cover for Frigidaire. This particular part was molded by Inland Mfg. Company, Dayton, Ohio on an H-P-M 48 ounce pre-plasticizing unit mounted on a 350 ton clamp. The weight of this part dropped from 26 ounces to 20 ounces, and the overall cycle was reduced from 85 to 45 seconds. Previously this hydrator cover was made on a 600 ton machine. It is a heavily ribbed part molded from clear polystyrene and has a projected area of 155 square inches.

Figure 7: Here are illustrated two sections of polystyrene cake covers. Both were produced in the same mold cavity, one with a 32 ounce competitive conventional machine, the other with a 48 ounce H-P-M pre-plasticizing unit. By the use of crossed polarizers, the stress patterns in these two parts are clearly shown.

Note the freedom of strain patterns in the part molded on the pre-plasticizing machine. This is typical of

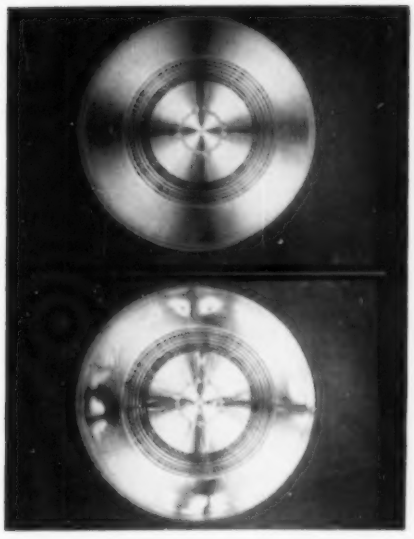


Figure 7. Cake Covers, showing relief of strain by preplasticizing.

the results obtained with pre-plasticizing units.

We have mentioned that the 48 ounce pre-plasticizing unit mounted on a 350-ton clamp machine has certain limitations with regards to mold mounting space, daylight and clamp ram stroke. Table 1 shows two proposed pre-plasticizing machines which we feel are ideally suited to most molding jobs. You will note that we have incorporated a great deal of daylight and stroke in each unit. It has been my privilege to inspect a large number of 60 ounce machines of conventional design. In most cases, the molding jobs being performed with these machines could easily be molded in either the 400 or 800 ton machines listed. Normally plasticizing capacity or the inability of the conventional machines properly to fill deep section parts has necessitated the use of 60 ounce units. Why should you mold a 10 ounce cake cover in a 32 ounce machine, or a 35 ounce deep section refrigerator part in a huge 60 ounce unit?

Right now, we are designing the 400 ton unit and the 800 ton unit will soon be scheduled for engineering design work.

Table 1

H-P-M PRE-PLASTICIZING INJECTION MACHINES

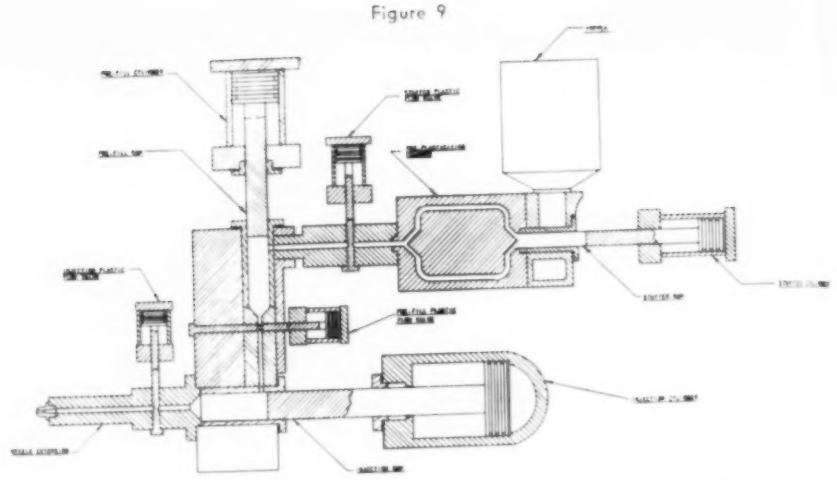
(New Proposed Sizes)

Clamp Tons	Maximum Mold Space	Daylight	Stroke	Max. "Poly" Shot
400	25½" x 36" or 40" x 21½"	54"	30"	48 oz.
800	36" x 48" or 58" x 26"	60"	36"	60 oz.

Figure 8: This is a close-up of the injection unit of the 200 ounce machine. Here is an illustration of a 200 ounce pre-plasticizing injection unit used in conjunction with a clamp unit of a coventional 60 ounce H-P-M machine. Clamping force is 1000 tons. This injection assembly is different from the 48 ounce unit previously described. The unit is not yet in production and is still under-going tests. Basically the pre-plasticizing chamber is mounted horizontally and a charge cylinder or storage chamber has been incorporated into the design. The 200 ounce rating is in polystyrene material and in addition to the regular hydraulic circuit of the 60 ounce machine, an 80 gallon gear pump is employed at 1000 p.s.i line pressure to actuate the stuffing cylinder and ram assembly and the plastic flow control valves. One of the outstanding features of this machine is its ability to plasticize material independent of the injection machine cycle.

Figure 9: Here is a diagrammatic drawing illustrating the operation of the 200 ounce pre-plasticizing injection unit. The plasticizing chamber has a capacity of 400 pounds of polystyrene per hour. One of the important features of this machine is the storage chamber for an additional 200 ounces shot at right angles to the pre-plasticizing chamber. Three plastic flow control valves are employed in this injection unit. The charging chamber permits the feed unit to operate regardless of the position of the injection plunger, therefore while the 200 ounce shot of the injection sleeve is being injected into the mold cavities, the next 200 ounce shot is being fed into the charging chamber and when the injection plunger is retracted, the hydraulic cylinder and ram assembly of the charging chamber forces the next 200 ounce charge into the injection sleeve. This particular charging action is very fast, so that the feed plunger can again be started to plasticize the next 200 ounce charge. With this exception, the injection unit operates in a similar manner to the 48 ounce unit previously described. This 200 ounce unit is designed to fit both the 1000 ton and 1200 ton mold clamping units of conventional 60 ounce H-P-M machines. Orders will not be accepted for this 200 ounce unit until the present pilot unit is completely tested and has proven itself in actual production.

Figure 9



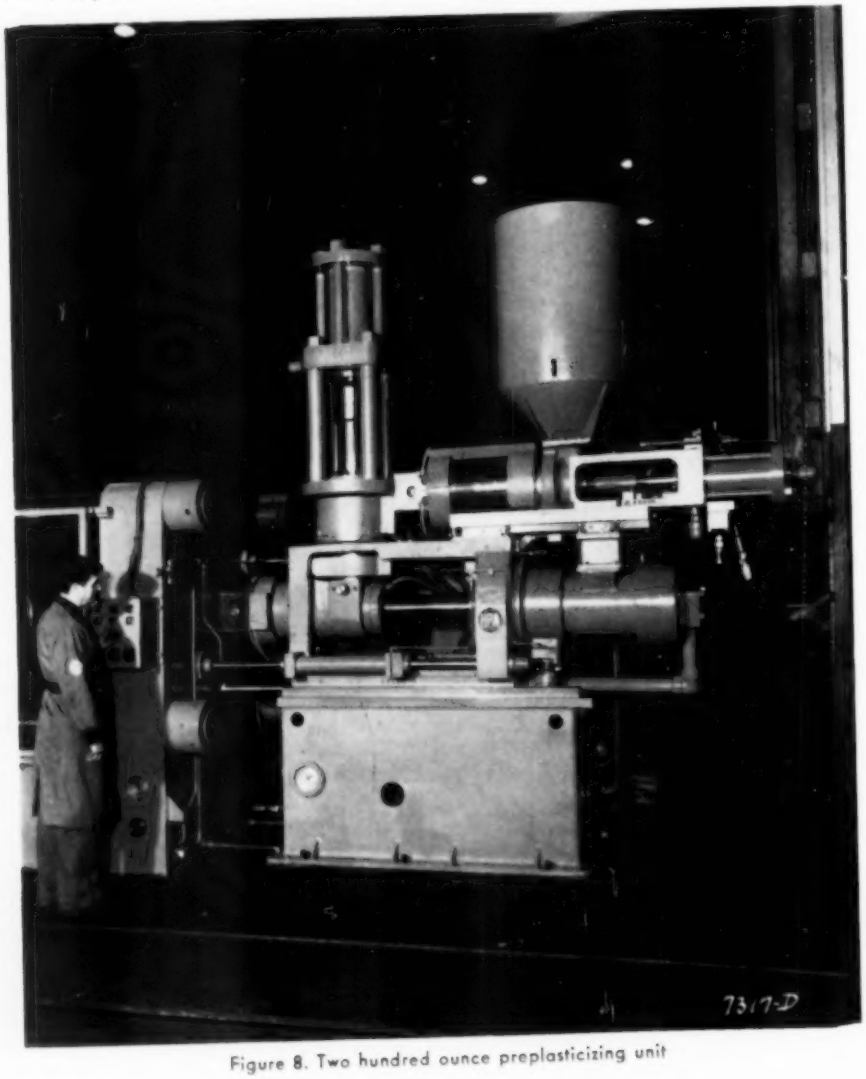


Figure 8. Two hundred ounce preplasticizing unit

Proposed Machine

We are planning a large capacity machine with a maximum injection shot of 300 ounces of polystyrene material. This is a vertical downward acting mold clamp unit with both injection and feeding units mounted in a horizontal position. We have received several requests to design a machine of this type and we are now actively negotiating with molders on this particular size machine. The mold clamping force will be 2500 tons and the mold mounting space will 72"x72". The machine will have a 96" daylight and a 54" clamp ram stroke. Both injection and feed units will be easily accessible for maintenance and inspection and the low position of the hopper assembly permits easy filling. Complete specifications of this machine are not yet available. We have mentioned this unit principally to show some of the thinking of both molders and H-P-M regarding large capacity machines. Such a machine would be ideally suited for the production of inner door liners for refrigerators, complete inside shells for refrigerators and similar parts.

THE *Injection* MOLDERSCOPE

By A. R. Morse

President, Injection Molder's Supply Co.

Injection Speeds—Injection Pressures

Now that I have been on the sidelines of the injection machine field objectively for several years, I can observe that all injection machines fall into two basic categories as pertains to those joint critical factors: injection speed, and injection pressure.

It is difficult to explain to a hydraulic engineer why full injection speed is so absolutely critical to the injection molder. During the explosive fraction of a second when the injected material first bursts into the cavity, part quality, part weight, part finish, and other critical part properties are determined once and for all. No amount of subsequent pressure exerted a hundredth of a second too late in the actual process of injection can ever correct those "molded in" difficulties.

On one group of injection machines (Impco, Fellows, Lester, Reed-Prentice, Demattia, for example) using vane type pumps it is possible momentarily to cut out the low pressure relief system altogether. Thus there is exerted against the plunger full pressure (1000 or 2000 lbs) at full volume. The plunger never hesitates when it meets resistance, but "walks right through," since it is being driven by an unusually large amount of oil at full pressure instantly and always available, just as though the machine was suddenly hooked into an accumulator circuit. The low pressure—high volume system thus is temporarily locked out during the actual moments of injection, and the machine operates as though it were being driven by a much larger motor-pump system.

On another group of machines using piston type pumps, the load demand regulates the volume of oil available to push the injection plunger. When the plunger starts forward it moves fast all right, but when it meets resistance it is forced to wait or to change speed during a critical fraction of a second when the molded part is just being born as the pump adjusts to the resistance and overcomes it. On these piston types of pumps, as I understand it, pressure is only available at the expense of volume (or in other words, speed). Unexplained molding and other difficulties are therefore more likely to be encountered with this type of injection system than with the full-volume, full-pressure type. We have proven this on several occasions where heating cylinders of identical design have been used on the two types of machines.

The hesitation we talk of here is **very slight,** but it occurs at an awkward time in the molding cycle, and is the root of a certain amount of trouble like part strain, burning, stuck pieces, oversize or overweight pieces, weld marks, mica marks etc., that can only be overcome by constant attention to the job, and or a great deal of work on the mold. These troubles are born in the critical fraction of a second when the pump shifts gears so to speak, or when the booster comes on too late in the first group of presses. The plunger builds up pressure of course, to overcome the resistance encountered just before the hot plastic bursts into the cold mold, **but no amount of subsequent pressure, or pressure applied too late will ever overcome defects already molded in.** This pressure coming too late simply backs off your press and gives you a part from .001 to .012 thicker than you planned to get. Even starved-weighed feed won't correct this trouble.

If you look at the injection cycle, it is observed that the initial explosive burst of the plastic into the mold on any machine requires a great deal of pressure. Then the pressure required may or may not fall off during the main filling time, but full pressure is required at the end of the stroke in any event. One way of reducing injection pressure is to increase injection speed. It is a common observation that presses in the first group will run at a lower injection pressure than presses using piston type pumps. This seems to be because the plunger moves faster during the injection stroke, and without the hesitation described above, and at full pressure so that there is no "gear-shifting" during the first critical burst of plastic into the mold. On the first group of machines, the low pressure cut-out must be so located that it operates before the plunger strikes the material. I know of some machines where it starts just a little late on some large shots, and the press performance can be materially improved by re-loading it.

At any rate, this clear cut division of the injection machine field into two distinct categories is an interesting engineering phenomenon. It directly affects so many molding factors that molders should investigate and understand it. While both types have their place in the industry, this basic variation in hydraulic circuits is one reason we always hear molders remarking that a job will run in one machine but not in another. A great deal of expensive re-work is usually required to adapt a die satisfactorily across this little understood gap between the two groups of injection machines which have this basic difference in hydraulic function.

Anyone considering moving dies, designing jobs etc. will do well to understand thoroughly how the two basic types of injection systems used in the industry function, and what effects they exert on the molded part. Usually the only way to cross the gap is with extensive alterations to the mold, changes in gating, venting, changes in actual dimensions of the mold sections etc. Men who have worked with both types of circuits can tell you more about it—if they have ever stopped to analyze it.

Penn Notes

Paul Roche

Significant personnel changes at Perry Plastics, Inc. have been announced by Mr. Jerry Stokes, President. According to the new announcement Wayne Osborne is now General Superintendent, Leo Schmelzer is now General Foreman of the Injection Molding Department, Gilbert Comstock is General Foreman of the Compression Molding Department, and Louis Huber is in full charge of the Finishing Department. These advancements have been made necessary by the recent enlargement of the plant in particular connection with the Compression Molding Department which has just undergone major expansion with the addition of modern transfer molding and pre-heating equipment.

We have also learned from Jim Quinn, President of Quinn-Berry Corporation, that that company is in the process of adding 100 per cent to its floor space. When this expansion is completed the plant will face West Twelfth Street of Erie and the added capacity will be absorbed by both molding and decorating departments. An entirely new office layout will also result from this building program.

We understand Applied Plastics Division, Keystone Brass Works, is also on the bandwagon with regard to plant expansion. A recent addition to the rear of their plant provides warehouse space, rendering the former plant fully available for manufacturing activities.

For the April 17th meeting of the Northwestern Pennsylvania Section, the Zukor's Club was selected, 1815 Peach Street, Erie, Pennsylvania. The speaker was Mr. Harold B. Freeman of American Cyanamid & Chemical Company, who discussed "The Reinforced Plastic Industry." This meeting was under the general supervision and sponsorship of Jerry Stokes, Perry Plastics, Inc. Attractive door prizes were donated by the sponsor.

HIRAM McCANN SPEAKS AT MAY MEETING

Plans Laid for 9th Annual Conference

Robert C. Davenport

Thursday evening, April 17th, the members of the SPE and SPI, presided over by Mr. John LaBelle, gathered together for their monthly dinner meeting.

Mr. LaBelle, who has been elected Chairman of the 9th SPE Conference, discussed plans for the 1953 Convention. Mr. James F. Lang was elected Co-Chairman of the Conference.

After the dinner, Mr. Reed Esterbrook moderated a debate on the subject, "Resolved: That the Responsibility for Designing, Construction, and Proper Performance of the Mold Rest with the Molder Rather than the Tool Maker." The discussion was carried on from the floor with Mr. John Kavanagh of the Standard Tool Company and Mr. Carl Wennberg of the Special Tool Co. taking the affirmative and Mr. Philip Graham of Worcester Moulded Plastics Corp. and Mr. Harry Sandberg of Northeastern Plastics taking the negative side.

Excellent points were presented by both sides. The rebuttal was so well balanced that a draw was declared. All participants received prizes.

The first meeting of the Planning Committee for the 9th Annual National Technical Conference of the SPE was held at the Statler, Wednesday, April 30th. SPE Members present represented the Eastern New England, Western New England, Providence, and Connecticut Sections. Mr. John LaBelle, Conference Chairman, presided with the assistance of his Co-Chairman, Mr. James Lang. Mr. Melvin S. Haas, Eastern New England Section Secretary, was nominated for and accepted the Conference Secretariate. Mr. LaBelle appointed Mr. R. Widmer Hubbs to be Conference Treasurer.

The Preliminary Report on the 8th SPE Conference was read and discussed along with some individual observations from certain key Conference Committeemen. Committee Chairmen were then appointed, the following chairs being filled:

Company Registration and Favors Committee—Mr. George W. Martin of Noma Electric Corp.

Finance and Budget Committee—Mr. R. Widmer Hubbs of the Harwid Co.

House and Banquet—Mr. James F. Lang of Bakelite Corp.

Ladies Entertainment Committee—Mr. Fred Langhorst of Stanley Chemical Co.

Printing Committee—Mr. Raymond Mazur of American Cyanamid Co.

Prize Paper Committee—Mr. Sylvan Simon of Bolta Co.

Program Committee—Mr. John T. Moore of Tennessee Eastman Corp.

Publicity Committee—Mr. Robert W. Crawford of Monsanto Chemical Co.

CO-CHAIRMEN: Mr. Lew Pentland of Durez Plastics & Chemical Co.; Mr. William Dunnican of the Synvar Corp.

Registrations, Reservation and Information—Mr. Jack G. Fuller of Hercules Powder Co.

Sergeant at Arms—Mr. Arthur A. Staff of the Koppers Co.

Speaker Committee—Mr. Arthur W. Logozzo of the Nutmeg Chrome Corp.

It decided that the Executive Committee, in order to be kept small and manageable, would consist of the following: Conference Chairman, Co-Chairman, Secretary, Treasurer, and the Chairman of the following key committees, House, Program, Publicity, Registration, and Speakers.

Mr. Fred Potts, Sales Manager of the Statler, dropped in for a few minutes and assured us that facilities would be more than adequate for our needs.

Preliminary plans indicate that there will be two luncheon meetings, the first on Wednesday, January 21st, followed by the Business Meeting, the second on Friday, January 23rd, featuring the keynote speaker. The banquet will be held Thursday evening and will be the main celebration. A special program is being arranged for the ladies who will be guaranteed an entertaining visit in Boston.

The May meeting promises to be an excellent one with a talk on "Plastics Future" by Mr. Hiram McCann, Editor of "Modern Plastics." Mr. McCann, born in Canada, has been in editorial or management capacity ever since his graduation from McMaster University in 1929. He joined **"Modern Plastics"** in September 1945 as Eastern Editor, became Associate Publisher in September 1946, and editor in September 1948. He became editor of **"Modern Plastics Encyclopedia"** in 1949 thereby heading up an educational and publishing institution which is recognized all over the world as a main source of information on plastics.

New members joining the Eastern New England Section, SPE, swell our ranks to 71. They are:

Mr. Maynard Axelrod, Maynard Plastics Corp.; Mr. N. E. Benedict, Standard Tool Co.; Mr. John Polten, Jr., Bolta Products, Inc.; Mr. Francis Dooley, H. Muehlstein Co.; Mr. Robert Fish, William Whitman Co.; Mr. Paul Gerren, Versa-Tile Co.; Col. Albert Gottlieb, Standard Pryoxoloid Corp.; Mr. Richard Paul Kahn; Mr. J. Mark Marmen, Rex Corp.; Mr. Ralph Mondano, Raytheon Mfg. Co.; Mr. R. D. Pillsbury, Rohm-Haas Co.; Mr. J. Murray Stevens; Mr. William G. Van Vliet, Dewey & Almy Chemical Co.; Mr. George Wilson, Textiloid Products Co.

Northern Indiana Meet Hears About Glass Reinforcement

Meeting of the Northern Indiana Section of the Society of Plastics Engineers, Inc., was called to order by Cecil W. Armstrong, acting president, on April 4, 1952, at 8 P.M. in the Chamber of Commerce at Fort Wayne, Indiana.

The minutes of the previous meeting were read by the Secretary-Treasurer, Philip A. Leonard, and were approved.

The program for the evening was a movie, "Fiber Glass Reinforced Plastics," and an exhibit and talk on Fiber Glass Reinforced Plastics by J. D. Lewis and M. J. Flanigan of the Fiber Glass Corporation, Toledo, Ohio.

The attendance at this meeting was approximately 60 to 70 people at an informal dinner meeting held at Manocchio's Grill and Restaurant, Fort Wayne. Eighteen members and guests were present.

Powell Talks To Toledo

Robert F. DeBrock

The April meeting of the Toledo Chapter of the SPE was held at Harrison's Ranch House on April 22 at 7 o'clock. After a dinner session, a short business meeting was held including reports from the various committees and tentative plans for the June meeting which will be a combination dinner and golf party.

The speaker of the evening was Mr. R. W. Powell, of the Hydraulic Press Manufacturing Company, Mount Gilead, Ohio, who presented a paper on "Pre-Plasticizing." Mr. Powell illustrated his talk with various slides and photographs as well as a large display of examples of polystyrene items which had been molded using the pre-plasticizing method.

St. Louis Talk on Vinyl Plastisols

"Industrial Application of Vinyl Plastisols and Vinyl Air-Drying Coatings" was the topic chosen by Frank Gollub, chief chemist of the Dennis Chemical Co., at the April 22nd meeting of the St. Louis SPE. The speaker illustrated his talk with a wide assortment of vinyl toys and industrial products.

"Eyes of Flight," a film by Rohm & Haas, depicted the fabrication and care of aircraft acrylic canopies and windows.

AUTOMOTIVE PLASTICS

John Totten

Ford Motor Co.

The requirements for automotive plastics applications vary according to the part use. Plastics are used where they are superior to metal, or offer unique design advantages.

As plastic materials are developed and placed on the market, they are evaluated in the Rubber and Plastics Laboratory. The data resulting from the evaluation is examined for use in current applications or filed for future reference. Broadly speaking, applications for plastics in our automobiles are classified in three groups—interior, exterior and under the hood. Further division may be made by subclassification into functional, semi-functional and decorative applications.

Some general requirements can be made for the foregoing classifications, bearing in mind each application will have, in addition, certain characteristics peculiar to itself. Those general characteristics are:

Interior:

1. Dimensional stability at a continuous operation temperature of 170°F.
2. Colorfastness to light—200 hour exposure in Fadeometer.
3. Chemical resistance to common cleaning solvents, auto finish cleaners and polishes.
4. Resistance to staining and migration when in contact with other organic surfaces.

Exterior:

1. Absence of crazing, fading or other degradation which would detract from the part's function or appearance after three years exposure in Florida and Arizona.
2. Resistance to road film, common auto body cleaners and polishes, gasoline and other solvents or cleaners used around automobiles.
3. Dimensional stability at the extremes in service temperatures—-50° F. to 180°F.
4. Resistance to staining and migration when in contact with other organic surfaces.

Under the Hood:

1. Dimensional stability — continuous operating temperature at 225°F.
2. Resistance to oil, gasoline, anti-freeze, battery acid and water as fluids and or vapors.
3. Resistance to ozone.
4. Electrical resistance, high voltage and arc resistance.

To select the right material for a specific application is often simple and, at other times, somewhat complex. A successful formula we use goes something like this: First we list the performance requirements in detail, what the part will be exposed to— temperatures, vapors, fluids, strength characteristics and other factors that must be met are recorded. Next the assembly of which the part is a component is studied in detail. The tentative dimensions are checked versus the tolerances which can be accepted in the molding operation.

The extremes in service requirements are listed and then we are ready for material selection. The eligible materials are listed if, of course, there is more than one available that can meet the requirements. The material which will be the most economical in producing the quality level desired is the material selected. Very seldom does the material which is the lowest in cost per cubic inch prove to be the most economical buy.

Specific Applications

Some generalizations can be made regarding materials for specific applications. For lenses, tail lamp, parking lamp, license plate lamp and back up lamps, the acrylics are the sole choice at the present time. The latter holds true for any other exterior applications in which a rigid thermoplastic is necessary. Interior trim such as control knobs favor the cellulosics. However, parts to be in contact with pyroxylin, or vinyl cellulose acetate materials proposed, should be checked for migration and staining tendencies. Cellulose aceto-butyrate or ethyl cellulose does not exhibit the same tendency toward migration and staining. Larger parts which, because of color requirements, transparency or other factors precluding the thermosets, favor the acrylics, ethyl cellulose or cellulose aceto-butyrate. Polystyrene meets dimensional stability requirements but offers problems in fastening and chemical resistance. Common auto cleaners and upholstery cleaners somehow are used to clean polystyrene, resulting in a frosted surface. Susceptibility to scratching and resultant crazing from human perspiration must also be considered. Pilot automobiles equipped with interior parts molded in styrene, and observed after nine months, did not compare favorably with other pilot automobiles in the same period trimmed with cellulosic or acrylic parts. Although a savings in cost is realized, a sacrifice in quality must be absorbed if polystyrene is to be used. In spite of the objections to polystyrene, it is always considered when specifying a material for a new part. Modifications of polystyrene are now being evaluated. These modified polystyrenes may eliminate some of the objections to wide usage of straight polystyrene for automotive parts.

Ignition Parts

Ignition parts favor the phenolics, cellulose filled or mineral filled. High dielectric strength, a measure of arc resistance and good dimensional stability are prime requisites. Electrical properties must not be subject to operating temperature fluctuations or appreciably affected when parts are coated with oil, water, gasoline or road film.

Nylon shows great promise for mechanical applications. Several parts formerly of powdered metal or nonferrous alloys are now molded of nylon. Better performance with coarser tolerances and lower cost are results of the replacement.

Successful applications are not usually the results of chance. Careful evaluation of the matter at hand and strict attention to detail are the nucleus of the formula. Replacement of glass with acrylics has opened new possibilities in automobile lenses. Optical efficiency has increased, breakage decreased. Considering the reduced breakage, simpler gaskets, less finishing required of the retaining bezel, the cost comparsion favors the plastic lens. Control knobs occasionally threatened with replacement by die castings continue to remain in thermoplastics. The stylist prefers the

plastic knob because of design and color potential.

An application is brought to mind where one plastic material replaced another plastic and two metal parts. A window regulator handle and remote control handle escutcheon consisting of a rigid thermoplastic, coil spring and metal spring retainer was replaced with a vinyl escutcheon containing an applied metal washer.

Fender Welts

Vinyl fender welts overcame a major objection to the artificial leather welts. The fabric-base fender welt has a wicking action holding moisture and, as a result, blistering of the paint and the inevitable corrosion of the steel occurs. Rubber was not a satisfactory substitute, since the color range was not great enough nor did the weathering resistance meet standards. Another case of a vinyl welt being superior to the supported artificial leather is the gimp binding on which seat upholstery details are sewn. Vinyl makes a much neater seam, since it will bend around small radii without crimping. In addition, the superior abrasion resistance will keep it looking new for the life of the car.

Parts with three dimensional ornamentation have caught the eye of the automobile stylist. Medallions that were painted metal are replaced with plastic. These parts are usually only decorative but, at the same time, may be considered the trade mark of the manufacturer. The striking effect of ornamenting transparent plastics from the reverse side invariably attracts much attention. As a result, performance specifications for these parts are very stringent. Lacquers and enamels must be so formulated as to have a slight etching effect on the plastic material to insure good adhesion. Light stability of the colors must be the very best obtainable. The back-off coating which covers the deposited coatings is a major factor in the expected life of the ornament. The back-off coating should have maximum adhesion and cover the entire surface which is decorated, in addition it should be an excellent moisture barrier. Penetration of moisture through the back-off coating and the decorative coatings results in blisters forming between the plastic and the coatings. This is the major defacing defect that occurs.

Not Perfect

At this point it may appear automotive engineers do not make mistakes in selecting plastics materials or using plastics where they were not intended to be used. Polystyrene and cellulose acetate have made an appearance in decorative medallions and exterior lenses. Polystyrene crystal will begin to take on an amber tint within seven months. Crazing will be apparent, as will loss of surface gloss. Cellulose acetate tail lamp lenses lose their red color, become a translucent white with accompanying crystallization in nineteen months.

A general purpose phenolic instrument panel appeared in an automobile about twelve (12) years ago. As could be expected, the panel cracked all too frequently. Had the panel been thicker or molded from a phenolic improved impact or high impact material, the application would have been a success. The instrument panel in an automobile is at a location where it is subject to transverse twisting action. Plastic details mounted on instrument panels or plastic instrument panels should be installed in a so called floating manner, which will absorb all or most of any applied torque action.

Instrument Panels

There are two more classics in instrument panels that should for the future be considered as what not to do in designing panels. One of these had a thin covering of cellulose acetate molded over a metal panel. Because of low elongation in tensile, cracking reached epidemic proportions. Another similar instrument panel was not plagued with cracking but rather with obvious distortion. The distortion was made apparent because instruments were placed in the panel forming concentric rings in the same plane. Variances in the opening, resulting from misalignment of the panel and the instrument, were one source of distortion. The use of self-tapping screws instead of spring tension fasteners caused puckers at mounting points. A related factor not obvious was variance in the cross-sectional contour of the steel panel. Fitting a thermo-plastic panel to a contour not always constant makes obvious the possibilities for distortion and fracture.

Steering Wheels

An example of a sound application made faulty by the incorrect selection of material is the door handle and window regulator escutcheon. Acrylic resin was selected primarily because a crystal escutcheon was desired. In service, the escutcheons cracked at the gate position or 180° opposite the gate at the weld and dropped off the shaft. Ethyl cellulose or cellulose aceto-butyrate molded in the same mold and subjected to similar performance conditions does not exhibit any cracking tendencies.

At the end of the 'thirties' plastic steering wheels appeared as standard equipment on the higher priced group of automobiles and as an accessory on other price groups. Almost without exception, these wheels were molded from cellulose acetate. Cracking seemed to occur regardless of the design of the wheel. Causes of the cracking were attributed to drivers lifting themselves into the automobile by using the wheel for leverage, or the coefficient of expansion of the material, or low elongation in tensile. Today, nearly every plastic steering wheel is molded from aceto-butyrate and cracking is virtually non-existent.

Just what percentage design contributes to the success of an automotive application in plastics is subject to conjecture. The procedure we use at Ford is to have the stylist, engineer, mold designer, laboratory, mold builder, purchasing agent and molding supervisor discuss the design, each from his viewpoint. Suggestions made at this point do much to preclude expensive tooling, molding, and finishing operations. Everything possible is done to give the stylist everything he is seeking but, in turn, economies are sought which allow the part to compete successfully with other non-plastic materials. In the past few years, industrial designers have grown more judicious in creating products calling for plastic materials. They are seeking assistance from material manufacturers and, in themselves, are more familiar with properties of plastics than they were in previous years. Design in plastics should emphasize the properties of the materials and obviously be a credit to the industry.

Design Needs

What does the automobile designer seek in plastics? Color range, wide possibilities in design, low cost, light weight strength, decorative potential and maintenance of original condition are the major considerations. The engineer, in addition, expects the part to meet performance requirements not just during the warranty period but for the useful life of the car. The dimensional tolerances specified on the part drawing should be commensurate with the performance requirements. By the same token, the part should remain within those tolerances at any of the extremes in service conditions.

Standardization

Standardization of certain parts in the automobile industry is nothing new. Brake master cylinders, flexible hydraulic brake hose, coolant hoses, windshield wiper tubing are examples. Work is now being carried out by S.A.E. committees to standardize material and color specifications for plastic tail lamp and fog lamp lenses. Discussions are in progress on the possibility of standards for ignition system parts.

Before lookirg into the future, what potential applications in plastics remain today? Electro plated plastics could replace many die castings. One manufacturer of phenolic molding powder has developed a conductive phenolic. Tests made on plated parts molded from this material were very enlightening. For example, they were subjected to a 500 hour salt spray without any apparent affect. A 500 hour exposure to 100% RH at 185°F. caused no blistering or separation of the metal from the plastic. Total immersion in water for 500 hours did no harm. Nylon, as mentioned earlier, is putting in a serious bid as a re-

(Continued on page 22)

E. D. Kennedy

The Role of

The ENGINEER in SALES

Edmund D. Kennedy

Monsanto Chemical Co.

The engineer has a great responsibility in the opening up of new markets. Particularly he must work with the salesman in seeing that the customer is led to selection of the right materials and proper engineering in a desired application.

The gravest problem before the plastic industry today is the job of opening up completely new markets for plastic products. Today our industry needs an unlimited horizon of expansion to take care of the greatly increased capacity. I don't need to give you a long string of statistics to prove to you that we are going to have a whale of a lot more plasties. Let's just look at the growth picture as we see it today. Here is an industry that has doubled in capacity in the last five years with an acceleration of the growth rate each year. You have all seen the news of our own and other material manufacturers' expansions to support the statement that certainly in the foreseeable future this growth will continue.

Market Finding Job

In the chemical and plastic industry it is not always practicable exactly to tailor production to existing market demand. Chemical and plastic material manufacturing capacity can't be added an inch at a time. New production units must be of size and capacity that will produce an economical product. Our industry certainly has great faith in itself and in its future to build the new manufacturing units, to add the new press capacity, to increase manufacturing floor space as has been done throughout the entire industry.

The proprietary end of the business can be expected to absorb some of this increased production. Population increases, continued high levels of personal income, better selling methods, increased public acceptance and improvements in function and appearance will increase our proprietary business.

However, this increase will be by degrees. The increases we are looking for must be more drastic than that.

Who is going to do this tremendous market finding job? Gentlemen, I'm sure that we (and I feel sure that I am speaking for all the material manufacturers) are going to do everything possibly can. But I can also assure you that even with doubled and redoubled effort on the part of the material manufacturer, the job is frankly too big for any one segment of the industry to tackle alone. There is such a variety of possible applications that their discovery and development must be done by the entire custom industry. Everyone in the custom industry must accept his share of the job and no one group of individuals can contribute more than you engineers.

Bold Action

The job calls for bold action, and in many organizations it will call for a radical change in selling policy and attitude. The beginning point is to shift selling emphasis from short range job getting to long range job development. We will never attain our industry goals as long as custom selling organizations concentrate on shifting existing jobs from other plastics companies' plants to their own—the usual inducement being lower price. The general pool of business is a pond that can rapidly work itself down to dry mud unless each of us puts as well as takes. The major selling emphasis of the industry must be on the development of new jobs.

There is no one who can contribute more toward development than you engineers. It is your knowledge, your imagination, your ingeniousness, your experience that your salesmen must have to back them up. I am sure that once having accepted this responsibility of leading salesmen along developmental lines you will find your own ways and means of putting thought into action. Just as thought starters, let me quickly cover here a few suggestions about your role in custom selling. I am not presenting these as startling discoveries of mine. They are obvious rules of good engineering, but because they are so obvious, it is surprising how many times they are overlooked.

Engineer's Role

The role of engineering in selling is briefly to encourage sound applications and to steer away from the unsound. Because I want to emphasize the encouraging role, let's quickly dispose of the steering away job. The engineer can bring reality into the salesman's dreaming. A good salesman is a born optimist. I don't want to imply that all engineers are born pessimists, but the engineer can bring his selling team back to reality with facts and good reasons why an application isn't sound.

Obvious misapplications are easy. If the salesman brings in a dream of an injection molded cake pan to bake cakes at 350°, the engineer can gently point out to him that to say the least he is a little ahead of the times. Ones as obvious as this are easy, but where real engineering guts and integrity are required are those borderline cases which might work once in a while but which the conscientious engineer knows are not right. These are the ones where the engineer must listen to that still small voice and not yield to that old devil of expediency or "the customer wants it this way."

Now let's move quickly to the encouraging role. In the engineering role of stern poppa to the salesman, he must not allow himself to become too hidebound. Sometimes a salesman's ideas might sound a little wild, but there are wild ones that can pay off. Remember the ha ha Fulton got and keep an open mind.

And referring back to the borderline cases there are some of these where ingenious engineering and deep digging might find an answer. In a case brought before our own Technical Council our engineers turned thumbs down on a suggestion for injection molding an expendable part in processing an architectural component. The reason was the excessive temperature encountered when the product was heat dried. Their decision was certainly justified on the facts as presented. However, on digging deeper it was developed that the customer in order to gain the economy and advantage of plastic was quite willing to make some minor adjustment in his process so that drying would be at room temperature allowing the whole job to be again sensibly reconsidered.

There are many cases where the application as first described seems

impossible and unsound. However, when ingenuity and deep digging are employed it is possible to strike pay dirt. The customer may be quite willing to consider simple design changes which in turn will change the whole picture favorable for plastics.

This suggests another line of action in which the engineer can be of tremendous assistance to the salesman—that is by extending the sale. Here's what I mean. The salesman has developed an interest on the part of the customer in a plastic handle on a business machine. The imaginative and progressive engineer looking at the job as a whole sees the much larger opportunity of a molded housing for the main mechanism. The engineering and selling team can sell the customer handle plus housing and everybody's happy.

The engineer can train and assist the salesmen to help them bring back a complete picture of the job the first time without several time-consuming return trips for answers to questions that should have been asked the first time. Some organizations have had their engineers develop a form which the salesmen completes in the field on every prospective job. While it is difficult to have a form which will be flexible enough to meet all conditions, any attempts in this direction will be useful in suggesting to the salesmen questions he should be asking. Whatever method you use, make certain your salesmen are equipped to get the information needed to make an intelligent analysis of the job.

Appearance Important

In many fields appearance is important. The engineer must accept as part of his responsibility the job of making the product look right as well as making it work right. Good appearance is one of the big advantages of just about all of the plastics, and the engineer should help the sales force by taking full advantage of it. In looking over several thousand plastic objects over the course of the last few years, I have found many of them weak from the appearance standpoint. While there has been a notable improvement in this direction, there is plenty of room for more improvement. Too many of the objects viewed showed a total lack of artistic and appearance considerations. As artists, the designers were good mechanics. The answer lies in recognizing the importance of appearance in certain jobs and acknowledging that good appearance often calls for talents beyond your organization. Often a good industrial designer can earn his fee through improved appearance alone.

Closely akin to the subject of appearance is a general area which I can only define as common sense in engineering to guide the salesman and the customer. This "common sense" approach calls for consideration of all the factors in design over and above those which are the normal jobs of the engineer.

An example of what I mean is the case of a very excellent deep freeze container. It was very nicely designed with good appearance, good strength, well-fitting covers, etc. It had, however, one fatal defect. It did not fit in even multiples in any direction in any deep freeze basket we could find. Two of them were not enough, and three of them were too many.

The biggest teamwork job that the engineer can do today with the sales force is the selling of pride of material. The engineer must help us get away from the idea that a plastic application can be considered only if it can show a tremendous price advantage over other materials. Sure, it's fine to have a price advantage, but we are limiting the horizons of the plastic industry if we are satisfied to limit our selling attack to those jobs where price is the big consideration.

The engineer, more than any one individual in the industry, can sell pride of material. The engineer recognizes the limitations of plastics materials, but he is just as conscious of their good qualities. He knows that the universally perfect material is yet to be found. Glass breaks—iron rusts—wood rots—gold and diamonds cost too much—all materials have their negative side.

No one wants to sell plastics where they don't belong, but the engineer can do a big job in selling plastics as basic engineering materials and he can transmit his enthusiasm to the salesmen.

Automotive Plastics

(from page 20)

placement for powdered metal and non-ferrous bushings and bearings. Many parts now made from natural or synthetic rubbers could be replaced by the vinyls to advantage.

What of the future? Will the use of plastics increase? Will body parts be made of plastic? What the future has in store for automotive applications in plastics will depend on three things: further development of materials, advancements in processing machinery, and the ability to produce parts at costs competitive with other materials.

There have been enough misapplications of plastics on the market without making more. The public was oversold on plastics to the point where, so they thought, when all else failed, plastics would do the job. Quality is important, as we all know so well. A salesman basically has three things to sell: price, quality and service. We have the same three factors to keep in mind as we engineer in plastics.

I would like to outline briefly the quality control measures we use at Ford to insure the production of sound plastic parts. Each batch of molding material is tested in the laboratory, according to the specifications it is purchased under. Molding cycles are based on laboratory evaluations of the parts molded and cycle tolerances are specified. At designated frequencies, a percentage of parts are sampled at random and performance tests made. Statistical control charts are used at strategic points to assist the operators and supervisors in knowing their quality level at all times.

The value of quality control procedures used in our molding department cannot be over-emphasized. Quality control has many advantages—one of them alone should be sufficient to make every manufacturer a user and a booster. That one advantage singled out is—scrap in excess of an acceptable or chance level will result if a current trend in operating conditions continues. In other words, you have an advance warning of trouble that lies ahead unless corrections are made in processing to bring the process back to a desirable pattern.

In summation, I wish to emphasize the continuing need for sound engineering both in design and materials for plastics parts in automobiles. Be certain of your facts—get all of them. Engineer for the extremes in service conditions and adequately cover all of the performance requirements. We should remember there are very few products in addition to automobiles subject to such extremes in operating conditions. Any automobile coming off an assembly line might be used at the equator or near a polar region.

Closed Mold Molding Practice is Topic at Rhode Island

Robert J. Feuchter

On April 24 the Rhode Island and S.E. Mass. Section of the Society of Plastics Engineers had their regular Dinner Meeting at the Wayland Manor in Providence, R.I. After an extended Social Hour and Dinner, we had as our Speaker Mr. Edward F. Borro of the Durez Plastics & Chemical Company who read his paper on "Closed Mold Molding Techniques." The result of a long program of research by the Durez Plastics Company, it covered the various types of round, square and rectangular gates—discussing each method. Important factors—minimum use of pressure, requiring less clamping tonnage—longest possible flow of material with a minimum of reaction for strength and dimensional stability—tubular insulation allows the material to enter the cavity at much higher temperatures, resulting in molding of uniform density without weld marks.

A series of slides with comparative figures illustrated the entire talk which was well received by our members. A lively discussion period followed the talk and each member received a copy of the paper covering the entire subject.

The Panel on—

MILITARY APPLICATIONS

The panel on Military Applications held at the 8th SPE Technical Conference was moderated by Kenneth Gossett of Gossett and Hill. The panel was recorded, and part of it is here transcribed. The contribution of Warren Stubblebine, and the question period following the panel will appear in another issue.

Panel members included Colonel Sundberg, Air Procurement; John Alfers, Bureau of Ships; Gerald Reinsmith, Army Ordnance.

COLONEL SUNDBERG—

The use of plastics in aircraft has increased steadily during the last few years. Almost every existing form and variety of plastics material may be found in some application in aircraft. Thermoplastic materials are used in molded, extruded, and cast sheet forms for such applications as flexible conduit, cable insulation, and other electrical applications, for control wheels and knobs, and for aircraft glazing, such as canopies. Thermosetting molded materials are used in electrical insulation and miscellaneous equipment parts. High pressure thermosetting laminates are used. Low pressure laminates are used primarily for radio and radar antenna housings, and other exterior structural parts, for ducts and backing for self-sealing fuel and oil cells. Plastic coatings and adhesives are widely used in aircraft components.

Aircraft

The principal applications of low pressure laminates in aircraft may be divided into three classifications. First, are those requiring dielectric properties, such as radio and radar antenna housings. However, it should be remembered that since these are structural parts, mechanical strength properties are also very important in these applications. Second, are those relatively light stressed parts where fabrication advantages enable them to be produced more cheaply than the metal counterparts. In some cases, there is also a savings in weight due to metal minimum gauge considerations. Third, are those where the gunfire characteristics are advantageous when compared to metal. Particularly, backing for self-sealing fuel and oil tanks. Successful use is being made of low-pressure laminates, principally glass fabric based polyesters, in all three of these classifications. However, there are certain problems and deficiencies in connection with these materials which are regarded as serious and limit their use.

First, it is desired to improve certain strength properties, particularly modulus of elasticity, and at the same time reduce cost and improve fabricating characteristics. It appears that this could be accomplished at least to some extent by making available an unwoven parallel fiber polyester resin warp material ready to laminate.

Glass Fabric

Second, on present or future glass fabric base materials, it is desired to reduce the drop-off of strength properties occurring after exposure to a high humidity or water immersion.

Third, for elevated temperature applications, such as for hot gas ducts, parts subjected to aerodynamic temperature applications, jet engine parts, or parts located near engine exhaust, materials of greater strength properties and resistance to deterioration at elevated temperatures are required.

Fourth, for backing materials, improved resistance to damage by gunfire is desired.

Fifth, it is necessary to obtain more extensive and reliable design data on mechanical properties under various conditions to enable more effective design and use of materials.

Sixth, for exterior plastic parts, improvement of resistance to erosion in high speed flight through rain is required.

Unwoven Glass

The Wright Air Development Center is working on all these problems, either through cooperative effort with materials manufacturers and fabricators, or through contract with various companies and research institutions. Work on an unwoven parallel glass fiber polyester resin material is being carried on by glass fiber manufacturers. The latter, as well as Wright Air Development Center, and others, are working on improving sizings for glass fibers. Three new sizings for glass fibers have recently been developed, one on air force contract, which increases the wet strength of glass fiber based polyester resin laminates approaching that of the dry laminates. For improved elevated temperature properties, the Wright Air Development Center has projects on the development of elevated temperature resistant low-pressure laminating resins of the silicone, phenolic, polyester, and other types.

Experimental resins have been developed under these projects which have vastly improved properties at elevated temperatures. To obtain design data, mechanical properties of various types of low pressure glass fabric based laminates are being obtained over a temperature range of approximately, minus 320 to 600°F. At sub-normal temperatures, impact, tensile and fatigue properties are being obtained. At elevated temperatures, tensile, compressive, flexural, fatigue and creep properties are being determined. The effect on strength properties of exposure to high humidities, water, and weathering, are being determined at room temperature.

Low Pressure

Since low pressure laminates are generally most effectively used in the form of sandwich construction particularly in the case of large radomes, extensive work is being done to obtain criteria for sandwich construction. In this connection, it may be noted that for certain radome applications very close tolerances on face and over-all thickness are required, together with a tapered over-all thickness construction. The desired results are being accomplished by employing premolded faces, mounting them between male and female molds and then foaming the core material in place between the faces. The core material is a polyester.

One of the major problems today which concerns the use of plastic materials in aircraft, is the erosion of exterior plastic laminate parts which occurs during high speed flight through rain. Development work is being conducted to obtain a plastic laminate material which will resist rain erosion. While no ultimate or final material has been found, the investigation has been successful in

that many factors affecting rain erosion have been determined. The mechanism of erosion is being studied and from the knowledge gained, it is known that certain physical properties of a material are required to provide rain erosion resistance characteristics. Also, it has been found that certain surfacing materials give relatively good protection to the plastic laminate and at the same time do not appreciably affect the electrical and mechanical properties of the laminate or sandwich construction. Two such materials have been approved for air force use. They can be applied by spraying and air drying.

JOHN ALFERS—

The greatest single factor in the increased consideration of use of plastics in the Bureau of Ships is the shortage of certain critical materials. In ship building, we use a great volume of the best of materials. For two reasons, principally, one the resistance to corrosion, and the other, the nonmagnetic characteristics. These materials, principally copper and nickel, are the ones it looks like should be saved and most emphasis placed upon. In the field of flotation equipment we've used a lot of balsa wood, which during the last war was short, and no doubt will be again. These activities involve three fields. One is piping; one is tanks — for fuel and water; and the other is flotation gear.

We have talked a lot over the past several years about piping systems, principally salt water systems. Work has been done, both laboratory work and field work, in piping systems and piping materials. The work has led itself to the point where it seems that both thermoplastic tubing and glass reinforced polyester tubing are quite ideal materials for piping systems, in place of copper and nickel which we use very extensively. This program has reached a point at present where two additional ships are going to be completely piped with plastic tubing.

Tanks and Floats

The field of tanks is another one where copper and nickel, aluminum and bronze, and those types of things have been used in the past. We're getting into principally glass reinforced plastic tanks. We have three contracts out at present to produce tanks in sizes from 1000 to 2850 gallons, let's say. These will be used for fuel, salt water and fresh water.

In the field of flotation gear, we have done a lot of work over the past several years on floats, buoys, and preservers and that sort of equipment. These are replacing cork and balsa wood with foam type materials. The most promising appears to be at present vinyl chloride foams for quite a lot of this work.

I want to emphasize that these applications which I have mentioned are not substitutes. We are expecting that they will be complete replacements for the metals previously used. In order to emphasize this, mention the piping system for instance. It looks like we can buy plastic tubing for less than half what we can buy copper-nickel and it is going to weigh less than half what the copper-nickel system weighed. So, on both scores, we are saving a substantial amount of weight and dollars, and in addition, all our tests indicate they are going to perform as satisfactorily as our previous materials.

In the case of tanks, it appears again that we can save at least half the weight of a copper-nickel tank and perhaps a great deal more. The costs on initial models, at least, are going to be something in the way of the same prices that we had to pay for the metal tanks, and as we go along and determine how best to make some of these items, I am sure they are going to come down in cost considerably from where they are now.

Flotation Gear

The one item of flotation gear which has reached the point of immediate use is a ring buoy. This was a cork item in the past. We now specify a semi-rigid poly-vinyl chloride material for this ring buoy. It is going to cost us just slightly more than a cork buoy did and its weight is going to be something in the same order also. We could save a lot of weight on it if we were allowed to but it seems in order to handle this thing properly, it has to weigh approximately the same as the previous one did.

It might be interesting to note that we run across reluctance in the selling of plastics around the Bureau on the score of quality. We have probably a thousand engineers in the Bureau who handle different types of ship's equipments and ships themselves. Each of these fellows is a potential customer for plastic articles. He is very reluctant, however, to take the propaganda that we in the services, and the salesmen from the plastics industry, put out about the quality or the worthiness of these plastic products. He bases much more of his decisions on what he can see and what his experience has been, particularly around the household.

Quality Wanted

I think we can all do a lot in a very direct effort to improve this situation. I think by designing and manufacturing and selling quality merchandise, we can do a lot of good for the overall industry. The fellows see a lot more today of the articles that are made for quantity, rather than those articles of plastics which are made for quality.

GERALD REINSMITH—

The army ordnance is primarily responsible for the development and improvement of weapons and combat vehicles for both the army and the airforce. Non-combat vehicles for the army, and some airforce and navy vehicles are also developed and procured by the Ordnance Corps. The Ordnance is also responsible for certain specialized aircraft such as, fire control spotter planes, and similar small aircraft.

The three main divisions of the Ordnance Corps concerned with material are research and development, and industrial and field service. Normally Research and Development carries on the desired action to have a new, or modified item developed.

The Industrial Division will make the required procurement while the Field Service Division handles the stocking, the storing, the issuance, and the maintenance of these approved or standardized items which in the Ordnance usually bears an "M" number. If they have a "T" number it means that they are not standardized.

Within Research and Development, the normal course of development on an item would be as follows:

The applicable materiel branch of Research Development, either directly or by contract with you people, or some industrial concern, will design the item. Should there be a question as to the choice of the proper material, the Design Engineer will request the aid of the Materiel Section, of which I am a member. If the material is plastics, the problem is usually assigned to our Ordnance Plastics Lab at Picatinny. If rubber, to our Basic Rubber Lab, at Rock Island, if a nonferrous metal, to Frankford, and Ferrous Metallurgy to Watertown, etc.

Suitable Material

After evaluation for the intended use, the Design Engineer is informed as to what material is considered most suitable, and frequently, even an experimental model is provided to them, for field or engineering tests. In all of this work, the Ordnance Corps strives to use plastics as an engineering material, not as a substitute for metal.

To this desired end, Ordnance has established contact for the preparation of a Plastics Design Handbook. The primary intent of this handbook is to provide Ordnance Design Engineers with a concentrated and readily available source of information to enable them properly to design with plastics.

For example, rocket launching tubes are under consideration, chiefly for their low-heat transfer rate which has been mentioned. In land mines, for their non-magnetic, non-electrical conducting characteristics. In personnel armor, for low weight compared to equal protection provided by steel; water immersed equipment, such as amphibious vehicles for corrosion resistance and low weight strength ratio. Again, an item that has been mentioned, in shrouds and tarpaulins, for increased weather resistance, coupled with lower weight as compared with conventional duct covers. This list

could continue much longer for plastics are a basic component.

Again, I desire to point out, that to design with plastics as a basic engineering material, not as a stop-gap substitute for another material is our watchword insofar as practical.

Many Classified

Many items under current development are classified in nature and cannot be discussed, but the following are some projects that might be of interest and I will briefly mention them. Contracts have been let to develop a 400 gallon trailer mounted water tank. Glass reinforced polyester is being used for this purpose. Previously, these tanks were made of steel, which presented corrosion problems and with aluminum, which proved to be inadequate in strength and rigidity and not amenable to easy repair in the field. It is anticipated that a tank can be provided in plastics that will overcome these difficulties. Amphibious trucks, commonly known as ducks, are another example requiring corrosion resistance, strength and rigidity. Contracts have been let for these hulls for these vehicles from glass reinforced polyesters.

Much military equipment is now supplied to front line troops by air. Since the packages must survive a drop to the ground from the aircraft, they are packaged in bulky and heavy crates. It is the bulk and weight of these packages that is a primary concern to the military, especially to the airforce who have that responsibility. Frequently, the storage capacity of the plane is reached before the weight level. To provide equal strength with much less requirement, glass reinforced polyester boxes are under development for all types of material. Another packaging problem, of great importance, is the preservation of bearings, roller bearings, ball bearings, all those bearings that go into moving parts. When one considers the number of bearings in military equipment, and then realizes that spares must be maintained at all principal depots, the magnitude of the problem is apparent. Molded containers of unplasticized vinyl chloride are being considered for this application. If they prove satisfactory for this application, the bearings can be packed in lubricant.

Powder bags for artillery are made of silk. Since this is not a domestically available material, adequate substitutes are very desirable. All synthetic fibers are being evaluated for this purpose.

In closing I should like to briefly mention another phase of our work relative to plastics which I am sure would be of interest to you people, as plastics engineers. Namely, the development of reliable engineering data. I want to stress "reliable." Not sales talk. This work is restricted to the development of data which to our knowledge is not available either commercially or in the military. These programs have as their objective the determination of data relative to plastics materials.

Quality Control

(from page 10)

used to analyze the data. Analysis of variance technique determined if the variability between groups of 10 was significantly large when compared to that within groups of 10. The probable limits of variation were calculated and the degree of variability tied into one of the measurable properties of the powder. As a result of this investigation it was possible to develop an improved material which was better than both previous materials.

The Statistical Quality Program

A great deal has been written on the subject of "How to Interest or Sell Management on the Benefits of a Statistical Quality Program" and on the dos and don'ts of how to get the program, once approved, underway. All too often the appeal to Management has been solely one of cost reduction without enough attention given to the less tangible benefits. High costs reflect faulty management and faulty management is often the end result of improperly trained supervision.

The expanding needs of the plastics industry will require trained men and the overall industrial demand is exceeding the supply. Industry will have to get along with less than their anticipated needs. To do the job required, therefore, these men will have to work more efficiently. To accomplish this an apprenticeship in statistical quality control will prove to be a valuable asset.

Statistical quality control as a background training for supervisory personnel was a panel subject for the third annual convention of the American Society for Quality Control. Mr. Reinhart, Manager Employment and Training of Sylvania Electric Products, Inc., states "Quality Control work provides excellent training in plant operation, as it requires familiarity with all phases of the production process, as well as the ability to work out practical inspection and sampling procedures, and the training and supervising of inspection groups.

"When I speak of Quality Control in its broad sense, I certainly do not mean inspection alone. I do mean, however, that broad coordination of the many functions which are required for successful manufacturing including Purchasing, Engineering, Manufacturing, Personnel, Industrial Engineering Inspection, Safety Engineering, and Sales."

Where better can a future production man initially learn about the processing and management problems of a molding shop than as a roving molding shop inspector; a future engineer learn through investigating and equipment capabilities; a future salesman by handling vendor and customer relationships in receiving and shipping. And all employing techniques broadly classified as Statistical Quality Control.

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Successful Designing for Plastics Molding

W. M. Halliday

This article continues consideration of factors which must be evaluated in designing plastic molds.

Where a component has to be provided with several holes or openings through side walls, these should preferably be situated at right angles to each other rather than at unusual angles. This cannot always be done, of course, but where it can, usually considerable simplification of the mold construction will result.

Holes which pass clean through the wall of a component, which are termed "straight-through" holes, may be formed by a single core plug extending from one block into a guiding hole in the opposite block, or alternatively by means of a pair of plugs carried one in each mold block, and, of course, contacting very closely on their end faces when the mold is closed. This latter construction is often employed when the hole diameter is small and its length considerable. By using such a construction the two portions of the core will have very much greater stiffness and rigidity to resist deflection tendencies during flow.

Dual core plugs of this type must, of course, be very accurately located and fitted into the mold blocks so that proper alignment of the two portions is obtained when the mold is closed.

Threaded holes may also be cored. These are usually formed, with compression molds, by means of sliding core plugs housed within a plain bearing hole in the mold block, and threaded on that portion extending into the cavity area. The core plug may have to be clipped into position in its housing by a spring or other device. The core will be extracted along with the finished molding and removed later.

External threads may also be formed, either by the use of collars or sleeves introduced into the mold block in a somewhat similar manner as above.

Countersunk or counter-bored shape of holes may also be molded in the wall of a component. Holes which have to be subsequently tapped out are usually countersunk in this fashion to allow better lead of entry for the tap, and to prevent the raising of a burr on the edge of the hole.

The best locations of core plugs in a mold will be those where the axis of the plug is nearest in agreement with the direction of the maximum material flow and greatest pressure. If holes have to be cored at obtuse angles to this pressure direction it might be found advisable to omit them altogether from the mold and machine at a later operation. This point requires careful consideration, especially if the component has a number of holes impinging at various angles into the cavity. The selection and disposition of such holes may best be determined by consultation with the mold designer. Alternatively, the mold designer should be allowed the widest latitude when developing the mold design.

(D) Ejection of the Component

It is also very necessary for the

(Continued on page 28)

Molding and Extrusion of Nylon Are Discussed at Connecticut April Meeting

David Mersey

The April meeting of the Connecticut Section was held on the 18th, at the Tivoli Restaurant in New Haven. This was an experiment, and was the first meeting to be held away from Bridgeport.

The business portion of the meeting was covered by two representatives of the E. I. Du Pont Co. Mr. R. R. Lescher talked on, "Molding of Nylon," and Mr. John Lackman on "Extrusion." They came prepared with some excellent slides.

Nylon is a generic term which refers to a group, rather than to one singular compound. Powders vary greatly in physical characteristics, and each type must be treated differently. The high melting point types have comparatively sharp melting points and low viscosities at melt temperatures; whereas the lower melting point nylons are more nearly similar to other thermoplastics in their behavior. Thus a wide variety of nylons may be manufactured; some types are most suitable for molding applications; others, for end uses such as bristles, textiles, wire coatings, etc.

Mr. Lescher said that nylon is as easy to mold as other thermoplastics if necessary consideration is given to the following factors:

1) nozzle design;
2) fast ram speed;
3) correct cylinder pressure;
4) mold design;
5) keeping powder dry.

Each of these factors was then discussed in detail.

In discussing nozzle design, Mr. Lescher stressed:

1) optimum temperatures;
2) type and location of heating bands;
3) taper;
4) number and size of filter plates;
5) location of thermocouples.

He also showed how freezing and drooling of the nozzle might be eliminated. A fast ram speed is required in molding nylon. The proper distribution of heat was the next most important consideration; this is usually handled on a multi-zone basis. Temperatures might differ with the type of cylinder and length of the torpedo.

The most common error in tool design is in having too many cavities per mold. These considerations should govern the number of cavities per mold.

1) shot capacity of the press;
2) clamping capacity of the press;
3) plastifying capacity of the press;
4) total number of parts to be produced.

Shrinkage usually falls between 0.010" and 0.020" per inch, depending on the thickness of the molded part.

Nylon comes packed in evacuated metal cans; however, where powder has to be dried, it is to be done at 175F for from three to six hours; scrap requires longer drying.

Mr. John Lackman covered the fields of extrusion and wire coating. He stressed the essential features of the nylon extruder, as:

1) electrical heat with controlled temperature zones;
2) proportioning type temperature controls;
3) nylon screw;
4) small cross head;
5) adequate screen pack.

The barrel should be comparatively long, and free from external flanges. Little frictional heat is generated; thus, nylon requires barrel temperatures as high as 625F., which renders electrical heating preferable to oil. The screen pack aids in retaining back pressure.

The "nylon screw" has constant pitched flights, shallow flights at the delivery end of the screw, constant depth of flights at the fixed section of the screw and abrupt change in depth of flights on the last three turns of the helix. This section, called the metering section of the screw, helps meter the flow and keeps the material spread thin, thus maintaining a uniform melt.

Similar techniques are used in wire coating and extrusion of tubes, shapes, etc., although in the case of wire coating, vacuum applied between the wire and the guider-tip pulls the cone of nylon closer to the die.

This meeting, with 52 guests and members, was the largest this section has ever had. At the March meeting we had one woman guest; in April another; now it looks as if we are getting our first woman member.

DETROIT NEWS

Emil R. Gazdick

The Detroit Section of the SPE will hold their next meeting at Adrian Cotters' Restaurant. Following dinner two films will be shown in keeping with the theme of the meeting: "Plastics in Sports Equipment." The films, one on fishing, the other on golf, will be followed by speakers on these respective subjects. John Totten of the Ford Motor Company will talk on the technical aspects of the theme.

This meeting promises to be one of the most interesteing of the year and it is expected to be well attended.

Two members of the Detroit Section of the Board of Directors have recently resigned.

Walter Kosy of the Chrysler Corporation is being transferred to the Dodge San Leandro, California plant. He will assume his new duties as rubber engineer within the very near future.

Mr. Kosy graduated from Wayne University, Detroit, Michigan, with a B.S. in Chemical Engineering. Following his graduation, he started to work for Lyons, Inc. in Detroit as plastics engineer in charge of their plastics department.

In 1950, Mr. Kosy joined the Chrysler Corporation in Highland Park, Michigan as a project engineer in their central engineering division.

Mr. Kosy has long been active in the SPE. For the last six years he has been on the Board of Directors, serving as treasurer, secretary, and last year as program chairman. He has also been active on various committees. Last but not least, he was the Detroit Section SPE Journal reporter for the last six years.

Courtney White is the other member of the Board of Directors who has resigned. Mr. White is being transferred to The Hague, Netherlands by Hercules Powder Company.

Mr. White graduated from St. Lawrence University, Canton, New York, with a B.S. in Chemistry. He later received his Masters Degree in Chemical Engineering from Massachusetts Institute of Technology.

Following graduation he joined the Hercules Powder Company as laboratory control chemist of the Parlin Plant. Later he became supervisor of the Parlon manufacture. Following this he became supervisor of plastics research of the Parlin Plant.

In February, 1950, Mr. White was transferred to the Detroit Office of Hercules Powder Company, handling technical sales of plastics molding powders.

In his new appointment, Mr. White will act as technical representative for the Hercules Powder Company of Wilmington, Delaware with N. V. Hercules Powder Company, one of their foreign subsidiaries.

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Successful Designing

(from page 26)

component designer to consider in some measure the particular manner in which the proposed component will have to be ejected out of the mold, and in particular whether the intended shape and form will lend itself to simple and quick ejection.

In the case of an injection molded part, usually if the internal shape can be formed by means of a solid core plug, so much the better, because this will enable a simple push-off mechanism to be employed for ejecting it out of the mold. A number of cylindrical rods are generally used for this purpose, these being passed through holes in the movable block member, and affixed at the rear to a plate or other appliance capable of retaining them together. The whole ejector plate will be slidable within the mold block. The ends of the rods will be set level with the parting line surface of the block on the edge of the cavity. All the rods will have to be disposed relative to the cavity area so as to bear upon selected portions of the component wall.

The point which the component designer has to bear in mind in this connection is this: Where each ejector rod touches the wall of the component a collar flash ring of some degree will be formed. Although such ejector rods are closely fitted within the block, a marking of some kind is unavoidable.

To obviate unsightly marking of essential surfaces on the molded component, therefore, close attention must be given to the location of ejectors in relationship to those surfaces where the slightest blemish would prove undesirable. Sometimes ejection may be accomplished by means of a sliding sleeve, large enough in external diameter to cover the component at its widest diameter. The molded article would thus be pushed off a core plug without producing any rod markings at all.

An alternative method often used is to make the core plug retractable within the mold block, so that the molding will fall of its own weight when the core is drawn back at the appropriate instant after the mold has been opened.

These are all points well meriting the careful attentions of the component designer when he is settling the final shape and form of the part. If consultations can be made with the mold designer so much the better. He will often be able to advise quite simple modifications of shape, etc., for simplifying the essential operation of ejection.

(E) Requirements of Mold Construction

The shape of the component and the type of mold to be constructed are also very intimately related, which is yet another factor to be kept in view by the designer of a component. Whatever shape is finally selected, this will have to be produced in reverse form in a steel mold.

With some shapes it may be possible for the tool maker to machine them directly into mold blocks. Other forms may require a mold having a built-up type of construction, employing a number of separate mold units so arranged and fitted together to give the required cavity shape. Each unit may contain a portion of the cavity formation.

Two important considerations arise in this connection, which will claim the interest of the component designer.

The first is that of mold cost. A complex built-up construction required to reproduce a difficult shape may prove far more costly than a solid type of mold construction. Often a very small or simple alteration in the shape of a component will permit the latter kind of mold being employed rather than the built-up mold. Expert advice on this point should always be obtained from the mold designer.

The second point relates to the quality of the component. With a built-up type of mold construction it is very likely that there will have to be a number of intersecting joining surfaces in addition to the normal parting line of the mould. These may be a source of surface blemishes on the finished part by reason of the small flash arising therefrom. Such flashings and marks may prove difficult to remove, a task likely to add to the unit cost of the components. Here again this is a matter best decided by the mold designer, who should be afforded freedom to adapt the shape best to suit all requirements of mold construction and manufacture.

Very often where a built-up type of mold has to be employed it will be possible, by only slightly altering the shape to obviate numerous intersections and joints of the above kind. Alternatively beadings, ribs, or steps, may be added to the component shape locating such features at the points where mold joints occur. Markings, etc., will then tend to be much more concealed and less conspicuous.

The mold designer's efforts to this end will often be greatly promoted if the component designer in the first instance has duly considered the point and endeavoured to develop a shape in conformity with these and other requirements of mold construction.

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(To Be Continued)

Cleavenger Is Manager

T. H. Cleavenger, formerly of the Koppers Company, has been appointed Chicago Regional Sales Manager for ANESITE COMPANY, 2112 Southport Avenue, Chicago 14, Illinois, manufacturers of plastic pipe and tubing and custom extrusions.

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